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NATIONAL ENERGY AND CLIMATE PLAN

for the period up to 2030

LIST OF ABBREVIATIONS AND ACRONYMS

ENTSO-E	<i>European Network of Transmission System Operators for Electricity</i>
ENTSOG	European Network of Transmission System Operators for Gas
LNG	<i>Liquefied Natural Gas</i>
LPG	<i>Liquefied Petroleum Gas</i>
SAIDI	<i>The System Average Interruption Duration Index</i> is an index of the average duration of long power supply interruptions in the system
TEN-E	Trans-European energy networks
TYNDP	Union-wide Ten-Year Network Development Plan
WAM	Scenario <i>with additional</i> policies and measures
WEM	Scenario <i>with existing</i> policies and measures
NPP	Nuclear power plant
GDP	Gross domestic product
RES	Renewable energy sources
WPP	Wind power plant
HPSPP	Pumped storage power plant
HPP	Hydroelectric power plant
GDS	Gas distribution system
GTS	Gas transportation system
ICE	Internal combustion engine
ESCO	Energy service company
ESU	Energy Strategy of Ukraine until 2050
EBRD	European Bank for Reconstruction and Development
LULUCF	Land use, land use change and forestry
KVVP	Installed capacity utilization rate
POWER LINES	Power transmission line
IEA	International Energy Agency
mln	Million
billion	Billion
NES	National Economic Strategy for the period up to 2030
NEURC (Regulator)	National Commission for State Regulation of Energy and Public Utilities
NECP	National Energy and Climate Plan until 2030

REFINERY	Oil refinery
NPSO	National Plan for Reducing Emissions from Large Combustion Plants
NDC	Ukraine's nationally determined contribution
DSO	gas distribution system operator
TSO	gas transmission system operator
OEC	The unified energy system of Ukraine
OKI	Critical infrastructure facilities
UN	United Nations Organization
SSO	Gas storage operator
TSO	Electricity transmission system operator
OSR	Electricity distribution system operator
GHG	Greenhouse gases
VAT	Value added tax
UGS	Underground gas storage facilities
UNFCCC	UN Framework Convention on Climate Change
NSDC	National Security and Defense Council of Ukraine
SES	Solar power plant
TPP	Thermal power plant
CHP	Combined heat and power plant
BC.	Ton of oil equivalent
UES	Energy storage installation

SECTION A. NATIONAL PLAN

1. OVERVIEW AND IMPLEMENTATION OF THE PLAN

1.1. Summary

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

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

The preparation of the NECP is Ukraine's obligation under the Energy Community Treaty¹ in accordance with the requirements of Regulation (EU) 2018/1999 and the European Commission's guidelines². The document is also prepared in accordance with the Decrees of the President of Ukraine of November 8, 2019 No. 837/2019³ and of March 23, 2021 No. 111/2021⁴. In addition, the development and approval of the NECP is a condition for the allocation of EU financial assistance under the future special instrument Ukraine Facility.

The NECP has been prepared in accordance with the clear requirements of Regulation (EU) 2018/1999⁵, as well as taking into account the experience of preparing similar documents by EU Member States and Contracting Parties to the Energy Community and previous developments⁶. The draft NECP was developed by a group of leading experts from the DiXi Group think tank and the Institute for Economics and Forecasting of the National Academy of Sciences of Ukraine with the support of the British Embassy (project "Ukrainian National Energy and Climate Plan Development and Preparation for Implementation") and the US Net Zero World initiative.

The Ministry of Economy of Ukraine coordinates the development of the NECP on behalf of the Government of Ukraine. Resolution of the Cabinet of Ministers of Ukraine No. 924 of August 19, 2023 established an Interagency Working Group on the preparation of proposals and recommendations for the development of the National Energy and Climate Plan⁷, which includes all key ministries and agencies.

The full-scale invasion of Ukraine by the Russian Federation has a serious impact on Ukraine's economy, including the energy sector. One of the most important aspects is the destruction of energy facilities as a result of hostilities, which could cause major disruptions in electricity and gas supplies. Attacks on power plants, gas pipelines, and other facilities can lead to an aggravation of the energy crisis and restricted access to key resources. Additionally, the hostilities affect the supply of labor and business operations.

¹ <https://www.energy-community.org/legal/acquis.html>

² Communication from the European Commission on guidance to Member States on updating national energy and climate plans for 2021-2030 (2022/C 495/02), <https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX%3A52022XC1229%2802%29&from=EN>.

³ <https://www.president.gov.ua/documents/8372019-30389>

⁴ <https://www.president.gov.ua/documents/1112021-37505>

⁵ https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=uriserv%3AOJ.L_.2018.328.01.0001.01.ENG

⁶ <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%BD%D0%BD%D0%BE%D0%B3%D0%BE/>

⁷ <https://zakon.rada.gov.ua/laws/show/924-2023-%D0%BF#Text>

According to the Ministry of Energy⁸, from October 10, 2022, to March 9, 2023, 271 hits on energy infrastructure facilities were recorded as a result of massive attacks using missiles and UAVs. Between November 2022 and February 2023, an average of 3.8 million customers had their electricity supply limited, and the maximum number of consumers cut off due to shelling during a systemic failure in the IPS of Ukraine reached 13.5 million⁹.

In general, from the beginning of the full-scale aggression until the end of the autumn-winter period of 2022/2023, about 50% of the available generating capacities and transformer substations of the Ukrenergo transmission system were temporarily lost (damaged and occupied)¹⁰. As a result of the full-scale invasion of Ukraine by the Russian Federation, since February 2022, consumption of natural gas (-28.7% in 2022 compared to 2021) and electricity (-30-35%) has significantly decreased, and natural gas production has decreased (-6.7% in 2022 compared to 2021).

Since the beginning of the full-scale invasion of Ukraine by the Russian Federation, the number of cyberattacks has increased dramatically - in the first 47 days alone, 200,000 cybersecurity-related events were recorded¹¹, from January 2022 to September 2023, CERT-UA recorded almost 4,000 cyber incidents¹². Most cyberattacks occur in the electricity sector. For example, the hacker group Sandworm, associated with the special services of the Russian Federation, amplified the effect of massive missile attacks on Ukraine's power system with cyberattacks on October 10 and 12, 2022¹³.

As of early 2024, the estimated environmental damage exceeded €56 billion with more than 3,300 documented court cases¹⁴. Prosecutors are investigating 280 criminal cases of ecocide and environmental war crimes.

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

- The continuation of hostilities and the need to take into account its consequences, uncertainty about the extent of the damage and the pace of recovery, which directly affect the possibility of implementing certain policies and measures, the pace of their implementation and success;
- Economic downturn and related energy poverty, leading to political reluctance to apply market-based pricing mechanisms for energy resources and related services;
- The weakened capacity of state institutions to simultaneously carry out crisis management in the context of hostilities and perform their key functions of developing and implementing public policies in the energy and climate sectors, especially given the challenge of reforming them in line with EU legislation;
- Large-scale debts have accumulated in the natural gas and electricity supply chains, which require a comprehensive settlement at the state level.

⁸ <https://www.kmu.gov.ua/news/500-dniv-viiny-enerhetyka-na-linii-frontu>

⁹ <https://mev.gov.ua/sites/default/files/field/file/proekt-rozporyadzhennya.pdf>

¹⁰ <https://www.undp.org/ukraine/publications/ukraine-energy-damage-assessment>

¹¹ <https://www.kmu.gov.ua/news/z-pochatku-vijni-shchodnya-fiksuyemo-v-serednomu-ponad-4-tisyachi-sprob-kiberatak-u-sferi-energetiki-farid-safarov>

¹² <https://home.treasury.gov/news/press-releases/jy1922>

¹³ <https://www.mandiant.com/resources/blog/sandworm-disrupts-power-ukraine-operational-technology>

¹⁴ <https://president.gov.ua/news/andrij-yermak-i-margot-valstrem-proveli-pyate-zasidannya-miz-88149>

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

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

- Reduced greenhouse gas emissions by 65% compared to 1990 levels.
- Climate neutrality of the energy sector by 2050.
- The share of renewable energy sources in the structure of gross final energy consumption is not less than 27%.
- Primary energy consumption is no more than 72,224 ktoe, final energy consumption - 42,168 ktoe.
- Expected energy savings in government buildings of at least 21.4 toe/year
- Reducing the level of import dependence (gross imports in total primary energy supply) to 33%.
- Deepening the diversification of energy sources and supply routes - no more than 30% from a single supplier
- Full and comprehensive integration of Ukraine's electricity and natural gas markets with the European markets
- Market-based pricing on energy markets with mechanisms to support vulnerable consumers
- Development and financing of innovation and research in the clean technology, renewable energy and low-carbon production sectors
- Increasing competitiveness

At the same time, the issues of completeness (sufficiency), relevance, and harmonization of policies and measures aimed at achieving the main strategic goals come to the fore, especially given the need to build a full-fledged climate governance architecture. In fact, the NECP is aimed at harmonizing energy and climate policies, filling gaps and adjusting the content of individual measures to achieve certain goals.

A detailed overview of the key energy and climate policies and measures related to the five dimensions of the Energy Union is presented in Section 1.2.ii. The modeling scenarios were developed in accordance with the requirements of Regulation (EU) 2018/1999, taking into account the specifics of public administration in Ukraine (see Annex 1 for details).

iii. Table with an overview of the key objectives, policies and measures of the plan

Measurement	Objectives.	Existing policies and measures (WEM scenario)	Planned policies and measures (WAM scenario)
Decarbonization	<ul style="list-style-type: none"> ● Reduced GHG emissions by 65% compared to 1990 levels. ● Climate neutrality of Ukraine's energy sector by 2050 ● Climate neutrality (for the economy as a whole) by 2060 ● Decommissioning of coal-fired generation by 2035 ● Reduce methane emissions by 30% by 2030 from 2020 levels. ● Strengthening the adaptive capacity and resilience of social, economic and environmental systems to climate change ● The share of renewable energy sources in the structure of total final energy consumption should be at least 27% in 2030 ● Indicative targets for RES in gross final energy consumption by 2030: <ul style="list-style-type: none"> - Heating and cooling - 35% - Electricity - 25.4%. - Transportation - 14%. ● Share of RES generation in total electricity production at 25% in 2030 ● The share of alternative energy sources (renewable energy sources and secondary energy resources) in heat production by heat supply facilities in 2025 - 30%, in 2035 - 40%. ● Increase the level of use 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 dioxide emission tax PM_D_WEM_02 Feed-in tariff for producers of electricity from RES PM_D_WEM_03 Stimulus tariff for heat from RES PM_D_WEM_04 Tax privileges for import of equipment running on RES PM_D_WEM_05 Exemption from customs duty on agricultural equipment PM_D_WEM_06 Exemption of bioethanol from excise tax PM_D_WEM_07 Tax incentives for electric vehicles PM_D_WEM_08 Stimulation of electric charging infrastructure PM_D_WEM_09 Stimulation of low-carbon municipal transport	PM_D_WAM_01 National Plan for Reducing Emissions from Large Combustion Plants PM_D_WAM_02 National Greenhouse Gas Emissions Trading System PM_D_WAM_03 Action Plan for Implementation of the Climate Policy of Ukraine within the framework of participation in the Global Methane Pledge initiative PM_D_WAM_4 Auction system for the allocation of support quotas for RES PM_D_WAM_5 Market premium mechanism for RES electricity producers (feed-in premium) PM_D_WAM_6 Direct power purchase agreements between producers and end-users (corporate PPAs) PM_D_WAM_7 Guarantees of electricity origin from RES PM_D_WAM_8 State Target Program for Fair Transformation of Coal Regions of Ukraine for the period up to 2030 PM_D_WAM_9 Strategy for Environmental Security and Climate Change Adaptation for the period up to 2030
Energy efficiency	Primary energy consumption in 2030 should not exceed 72,224 ktoe, and final energy consumption should not exceed 42,168 ktoe.	PM_EE_WEM_01 Activities of the Energy Efficiency Fund PM_EE_WEM_02 State Fund for Decarbonization and Energy Efficient Transformation PM_EE_WEM_03 Energy services in the public sector	PM_EE_WAM_01 Energy Efficiency Commitment Scheme PM_EE_WAM_02 State Targeted Economic Program to Support Thermal Modernization of Buildings until 2030 PM_EE_WAM_03 Buildings with near-zero energy consumption

	<p>The total amount of energy saved in end-use for 2021-2030 should be at least 16,405 ktoe.</p> <p>The expected energy savings in government buildings is at least 24.9 GWh/year</p>	<p>PM_EE_WEM_04 Minimum requirements for energy efficiency of buildings</p> <p>PM_EE_WEM_05 Certification of energy efficiency of buildings</p> <p>PM_EE_WEM_06 Exemplary role of public authority buildings</p> <p>PM_EE_WEM_07 Energy management in public authorities</p> <p>PM_EE_WEM_08 Energy management in local governments</p> <p>PM_EE_WEM_09 Local energy plans</p> <p>PM_EE_WEM_10 Regional offices for decarbonization and energy efficiency</p> <p>PM_EE_WEM_11 Energy efficient procurement</p> <p>PM_EE_WEM_12 Energy labeling and eco-design</p> <p>PM_EE_WEM_13 Pilot project on creation of favorable conditions for efficient electricity consumption in Ukraine</p> <p>PM_EE_WEM_14 Energy audit of large enterprises</p> <p>PM_EE_WEM_15 Intelligent energy metering systems</p> <p>PM_EE_WEM_16 Regulation of combined heat and power (cogeneration)</p> <p>PM_EE_WEM_17 Heat supply schemes</p> <p>PM_EE_WEM_18 Qualification of cogeneration units</p> <p>PM_EE_WEM_19 Ensuring heat energy metering</p>	<p>PM_EE_WAM_04 Assessment of the energy efficiency potential of the gas transmission system, electricity transmission system, gas distribution system, electricity distribution system</p> <p>PM_EE_WAM_05 Assessment of the potential for efficient district heating and highly efficient cogeneration</p> <p>PM_EE_WAM_06 Guarantees of origin of electricity produced by a highly efficient cogeneration unit</p> <p>PM_EE_WAM_07 Stimulating the development of highly efficient cogeneration</p> <p>PM_EE_WAM_08 Update of the Concept for the Implementation of the State Policy in the Field of Heat Supply</p> <p>PM_EE_WAM_09 Implementation of the State Target Economic Program for Energy Modernization of Enterprises - Heat Producers in State or Communal Ownership for the Period up to 2030</p>
Energy security	<ul style="list-style-type: none"> Reducing import dependence (gross imports in PPP) to 33%. Deepening diversification of sources and routes of energy supplies from third countries <ul style="list-style-type: none"> - ensuring diversification of supplies at a level of no more than 30% from a single supplier, - reducing the share of one supplier in the nuclear fuel market to 60% Increasing the flexibility of the national energy system Eliminating restrictions or interruptions in energy supply to increase resilience 	<p>PM_ES_WEM_01 Development of routes for import of oil products and natural gas</p> <p>PM_ES_WEM_02 Establishment of fuel cassette production facilities to meet at least 50% of the needs of Ukrainian NPPs</p> <p>PM_ES_WEM_03 Creating gas reserves (filling gas storage facilities)</p> <p>PM_ES_WEM_04 Creation of coal and reserve fuel (fuel oil) stocks</p> <p>PM_ES_WEM_05 Implementation of the first standard of conduct for gas infrastructure facilities (Standard N-1), standards of conduct for gas suppliers</p> <p>PM_ES_WEM_06 Meeting the minimum security criteria for electricity supply</p> <p>PM_ES_WEM_07 Establishment of a national system for the protection of energy sector C&I</p> <p>PM_ES_WEM_08 Experiment on construction, repair and other engineering and technical measures to protect the ESC</p>	<p>PM_ES_WAM_01 Incentives to increase gas production for maximum self-sufficiency</p> <p>PM_ES_WAM_02 Rehabilitation of oil refining and/or construction of a new complex</p> <p>PM_ES_WAM_03 Establishment of fuel cassette production facilities to meet all needs of Ukrainian NPPs</p> <p>PM_ES_WAM_04 Development of uranium production</p> <p>PM_ES_WAM_05 Creating minimum stocks of oil and oil products</p> <p>PM_ES_WAM_06 Implementation of EU rules on security of electricity and gas supply</p> <p>PM_ES_WAM_07 Ensure physical, engineering and cyber security of 100% of C&I facilities in the energy sector</p> <p>PM_ES_WAM_08 Creation of backup power sources for the I&C facilities, including the use of distributed RES generation</p>
Internal energy market (common goals, policies and measures)	<ul style="list-style-type: none"> Full and comprehensive integration with European energy markets Formation of market-based energy prices for all categories of consumers Effective mechanisms to support vulnerable consumers 	<p>PM_IM_WEM_01 Current procedures for planning energy infrastructure development</p> <p>PM_IM_WEM_02 Targeted monetized subsidies for partial compensation of energy services</p> <p>PM_IM_WEM_03 Retail price regulation and liberalization</p> <p>PM_IM_WEM_04 Universal service supplier / supplier of last resort</p>	<p>PM_IM_WAM_01 Promoting the development of new cross-border connections</p> <p>PM_IM_WAM_02 Additional procedures for planning the development of energy infrastructure</p> <p>PM_IM_WAM_03 Ensuring the independence of the NEURC</p> <p>PM_IM_WAM_04 Institutional support for the protection of vulnerable consumers</p>

	<ul style="list-style-type: none"> Achievement of wholesale and retail market performance indicators 	<p>PM_IM_WEM_05 Ensuring consumer access to important information</p> <p>PM_IM_WEM_06 Use of tools to facilitate comparison of commercial offers and consumer choice</p> <p>PM_IM_WEM_07 Simplified procedure for switching the supplier</p> <p>PM_IM_WEM_08 Development of organized wholesale energy markets</p>	<p>PM_IM_WAM_05 Application of online services for consumers (eConsumer)</p> <p>PM_IM_WAM_06 Measures to monitor and address energy poverty</p>
Domestic energy market: electricity	<ul style="list-style-type: none"> Integration of Ukraine's power system with ENTSO-E countries (interconnectivity) at the level of 10% by 2030 25% of RES in the electricity production mix in 2030 Adequacy and flexibility of the energy system Implementation of "smart metering" and "smart grids" in electricity Reducing power outages (SAIDI) to 150 minutes in urban areas and 300 minutes in rural areas (by 2050) 	<p>PM_IME_WEM_01 Incentive regulation of distribution system operators</p> <p>PM_IME_WEM_02 Support of active consumers by the mechanism of self-production (net billing)</p> <p>PM_IME_WEM_03 Simplification of permitting procedures for distributed generation entities</p> <p>PM_IME_WEM_04 Prioritization of renewable energy sources in dispatching</p> <p>PM_IME_WEM_05 Compensation for RES producers (at the "green" tariff) curtailments during redispatching</p> <p>PM_IME_WEM_06 Harmonization of price caps application in wholesale market segments</p> <p>PM_IME_WEM_07 Possibility for RES producers to choose the form of market participation and free transition between them</p> <p>PM_IME_WEM_08 Guaranteeing of green electricity buyback</p> <p>PM_IME_WEM_09 Promoting non-discriminatory integration into the grid and the market for demand response, energy storage and aggregation</p> <p>PM_IME_WEM_10 Application of service quality standards and provision of compensation to consumers for non-compliance</p> <p>PM_IME_WEM_11 Electricity supply to protected consumers</p> <p>PM_IME_WEM_12 Time-of-use prices for household consumers</p> <p>PM_IME_WEM_13 Dynamic prices for non-household consumers</p>	<p>PM_IME_WAM_01 Deployment of smart grids</p> <p>PM_IME_WAM_02 Aggregation development</p> <p>PM_IME_WAM_03 Application of pilot projects and demand-side management program</p> <p>PM_IME_WAM_04 Ensuring the development of energy storage facilities</p> <p>PM_IME_WAM_05 2030 State Targeted Economic Program for Stimulating the Development of Distributed Generation of Electricity from Renewable Energy Sources</p> <p>PM_IME_WAM_06 Tenders for the construction of generating capacity and implementation of demand response measures</p> <p>PM_IME_WAM_07 Implementation of real-time pricing</p> <p>PM_IME_WAM_08 Integration (coupling) of spot markets</p> <p>PM_IME_WAM_09 Integration (coupling) of the balancing market</p>
Domestic energy market: gas (including biomethane, hydrogen, oil)	<ul style="list-style-type: none"> Increasing and promoting biomethane production Ensuring 100% of gas metering Reliability and completeness of commercial gas metering Achieving sufficient volumes of domestic natural gas production 	<p>PM_IMG_WEM_01 Measures in place to ensure sufficient natural gas production</p> <p>PM_IMG_WEM_02 Establishment of a technical security system in the gas market</p> <p>PM_IMG_WEM_03 Switching to commercial gas metering in energy units</p> <p>PM_IMG_WEM_04 Ensuring the attractiveness of Ukrainian oil and gas infrastructure for foreign customers</p> <p>PM_IMG_WEM_05 Current measures to promote biomethane production</p> <p>PM_IMG_WEM_06 Basic annual offer of the natural gas supplier</p>	<p>PM_IMG_WAM_01 Establishing a legal and regulatory framework for the formation of future markets and building their infrastructure</p> <p>PM_IMG_WAM_02 Creating legal conditions for optimization of oil and gas infrastructure</p> <p>PM_IMG_WAM_03 Establishing systematic involvement of the Ukrainian side in EU processes related to the future of energy infrastructure</p> <p>PM_IMG_WAM_04 Additional measures to ensure sufficient natural gas production</p> <p>PM_IMG_WAM_05 Opening of natural gas exports</p>

			<p>PM_IMG_WAM_06 Determination of optimal technical parameters for gas injection into networks</p> <p>PM_IMG_WAM_07 Ensuring an effective management regime for GDSs</p> <p>PM_IMG_WAM_08 Setting up effective balancing rules</p> <p>PM_IMG_WAM_09 Additional measures to promote biomethane production</p> <p>PM_IMG_WAM_10 Strengthening of requirements for unbundling of DSOs</p> <p>PM_IMG_WAM_11 Ensuring 100% of gas metering</p> <p>PM_IMG_WAM_12 Development of a commercial gas metering system</p> <p>PM_IMG_WAM_13 Creating conditions for the use of contractual practice of voluntary reduction of gas consumption</p>
Research, innovation and competitiveness	<ul style="list-style-type: none"> • Development and financing of innovation and research in the clean technology, renewable energy and low-carbon production sectors • Implementation of clean energy solutions and low-carbon technologies • Increasing competitiveness 	<p>PM_RIC_WEM_01 Modernization of educational programs to cover the skills gap in the field of green transition and renewable energy</p> <p>PM_RIC_WEM_02 Availability of grant funding for research in the field of renewable energy and climate innovation</p> <p>PM_RIC_WEM_03 Developing corporate investments in climate technology and renewable energy solutions</p> <p>PM_RIC_WEM_04 Competitiveness of the Ukrainian economy against the background of implementation of EU legislation in the field of energy labeling and ecodesign</p>	<p>PM_RIC_WAM_01 Developing corporate and international partnerships in the energy and climate sector</p> <p>PM_RIC_WAM_02 Expanding research funding for renewable energy and climate innovation</p> <p>PM_RIC_WAM_04 Active attraction of venture capital investments in climate innovation and renewable energy companies</p> <p>PM_RIC_WAM_05 Development of exports of climate and renewable energy technologies</p> <p>PM_RIC_WAM_06 Promoting SME competitiveness through green transformation and access to new markets</p>

1.2. Overview of the current political situation

i. National and Union energy systems and the political context of the national plan

As a Contracting Party to the Energy Community, and as part of the EU accession process, Ukraine has committed itself to developing a NECP in accordance with Regulation (EU) 2018/1999 and the European Commission's guidelines.

Since 2016, Ukraine has been working to implement the EU-Ukraine Association Agreement, including the Deep and Comprehensive Free Trade Area. According to the Cabinet of Ministers of Ukraine¹⁵, as of 2022, 72% of the commitments under the AA have been fulfilled, in particular: in the energy sector - 75%, environment and civil protection - 77%, energy efficiency and housing and communal services - 75%.

On February 28, 2022, Ukraine officially applied for membership in the European Union. On March 1, 2022, the European Parliament adopted a resolution supporting the granting of candidate status to Ukraine, and on March 10-11, 2022, at the informal European Council summit in Versailles, EU leaders recognized Ukraine's European prospects and European choice, as set out in the Association Agreement, and supported the decision of the EU Council to invite the Commission to provide its opinion on this application in accordance with the provisions of the relevant treaties. On April 17, 2022, Ukraine submitted responses to the European Commission's Questionnaire on Ukraine's compliance with the political and economic criteria for EU membership, 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 status was made on June 23, 2022.

The European Commission, in its report on the "enlargement package" published in early November 2023¹⁶, noted Ukraine's significant progress in the implementation of the EU acquis. In particular, it noted the good level of preparation in the energy sector and the achievement of certain progress, despite the fact that the energy sector operated in extraordinary conditions due to the Russian Federation's attacks on Ukraine's energy infrastructure. Ukraine's legislation continued to be harmonized with EU legislation, in particular on the integrity and transparency of the wholesale energy market, renewable energy sources, the GTS operator, and the certification of the gas storage operator. However, measures taken under 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 made good progress. With regard to the environment, legislation has been adopted to further harmonize horizontal issues, water quality, waste management, chemicals and noise. However, progress was limited in terms of climate policy.

The Report on the Implementation of Commitments under the Energy Community Treaty for 2023¹⁷ contains an assessment of Ukraine's implementation of the Energy Community acquis for the period from November 2022 to October 2023 in 5 main areas (clusters). Ukraine as a whole has one of the highest scores: progress in implementation in the Energy Markets and Integration cluster is estimated at 69%, Energy Sector Decarbonization at 44%, Energy Security at 61%, Environmental Protection at 52%, and Regulatory Activities at 76%.

¹⁵

https://www.kmu.gov.ua/storage/app/sites/1/55-GOEEI/zvit_pro_vykonannya_ugody_pro_asociaciyu_za_2022_rik.pdf

¹⁶

https://neighbourhood-enlargement.ec.europa.eu/system/files/2023-11/SWD_2023_699%20Ukraine%20report.pdf

¹⁷

<https://www.energy-community.org/implementation/report.html>

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

In early 2024, the European Council supported the revision of the EU budget, which will provide EUR 50 billion for macro-financial support to Ukraine under the Ukraine Facility program for 2024-2027. The Ukraine Facility provides €39 billion to the state budget of Ukraine to strengthen macro-financial stability, as well as €8 billion 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 under the instrument will attract an additional €30 billion in investments. The Ukraine Facility also provides €3 billion for technical support, including funds to cover interest on loans.

Support will be provided on a quarterly basis, subject to the fulfillment of the reform criteria set out in the Ukraine Plan. The Ukraine Facility Plan envisages the implementation of structural reforms in the public sector, a number of economic reforms aimed at improving the business climate and entrepreneurship, and steps to develop priority sectors that can generate rapid economic growth.

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

Decarbonization (reduction of greenhouse gas emissions)

Ukraine was one of the first countries to ratify¹⁸ the Paris Agreement¹⁹ (July 14, 2016). The Agreement entered into force on November 4, 2016, on the thirtieth day after its ratification by 55 Parties to the United Nations Framework Convention on Climate Change²⁰, which are estimated to account for at least 55% of total global greenhouse gas (GHG) emissions.

Under the Paris Agreement, Parties are obliged to prepare, communicate and maintain consistent nationally determined contributions to the global response to climate change. Ukraine's first Intended Nationally Determined Contribution (INDC) was approved by the Government on September 16, 2015²¹, which automatically became Ukraine's first Nationally Determined Contribution (NDC) after the entry into force of the Paris Agreement.

According to the first NDC, Ukraine committed itself in 2030 not to exceed 60% of the level of greenhouse gas emissions in 1990²². Given that in 2012 Ukraine's GHG emissions were 375.4 million tons of CO2-eq (including LULUCF²³), which was 42.9% of the 1990 emissions level, it was assumed that by 2030 Ukraine's GHG emissions could increase after the restoration of the country's territorial integrity and economy.

¹⁸ Law of Ukraine "On Ratification of the Paris Agreement" No. 1469-VIII of July 14, 2016,
<https://zakon.rada.gov.ua/laws/show/1469-19#Text>

¹⁹ https://zakon.rada.gov.ua/laws/show/995_161#Text

²⁰ https://zakon.rada.gov.ua/laws/show/995_044#Text

²¹ Resolution of the Cabinet of Ministers of Ukraine "On Approval of the Expected Nationally Determined Contribution of Ukraine to the Draft New Global Climate Agreement" No. 980-r of September 16, 2015,
<https://zakon.rada.gov.ua/laws/show/980-2015-%D1%80#Text>

²²

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

²³ LULUCF - land use, land use change and forestry.

Ukraine's updated Nationally Determined Contribution to the Paris Agreement, which the Government approved on July 30, 2021²⁴, has significantly strengthened²⁵ Ukraine's contribution to tackling global climate change. Thus, the document envisages a 65% reduction in Ukraine's total GHG emissions by 2030 compared to 1990 emissions²⁶. The same goal is enshrined in the Decision of the Ministerial Council of the Energy Community No. 2022/02/MC-En²⁷.

At the end of January 2024, the Ministry of Environmental Protection and Natural Resources of Ukraine (hereinafter referred to as the Ministry of Environmental Protection) published a draft Strategy for the Formation and Implementation of State Policy in the Field of Climate Change for the Period up to 2035²⁸, which was developed to create an organizational and legal framework for the formation and implementation of state policy in the field of climate change and to ensure an effective transition to low-carbon development of the state and to take into account the goals of state climate policy during the post-war reconstruction of Ukraine. In addition, the Ministry of Ecology also published the draft Law of Ukraine "On the Basic Principles of the State Climate Policy"²⁹, which aims to define the legal and organizational principles of the state climate policy aimed at ensuring low-carbon development of Ukraine, achieving climate neutrality, adaptation to climate change, fulfilling Ukraine's international obligations in this area, as well as the principles of creating a national system of inventory of anthropogenic emissions from sources and absorption by sinks of greenhouse gases, and the functions of the

Ukraine has been a party to the Montreal Protocol since 1988 and has been fulfilling its obligations in good faith. In particular, the state policy in the field of regulation of economic activities with ozone-depleting substances and fluorinated greenhouse gases is being implemented. In 2020, the relevant Law was adopted³⁰, which regulates legal relations regarding the production, import, export, storage, use, placement on the market and handling of ozone-depleting substances, fluorinated greenhouse gases, goods and equipment containing or using them, which affects the ozone layer and global warming, as well as a number of other regulations in this area. The National Environmental Action Plan for the period up to 2025³¹ envisages the creation and maintenance of the Unified State Register of Operators of Controlled Substances (ozone-depleting substances and fluorinated greenhouse gases) during 2021-2025.

The Ministry of Ecology has developed a draft³² Law of Ukraine for ratification of the Amendment to the Montreal Protocol on Substances that Deplete the Ozone Layer, adopted at the twenty-eighth Meeting of the Parties to the Montreal Protocol on October 15, 2016 in Kigali, Rwanda (hereinafter referred to as the Kigali Amendment), to phase out the consumption of fluorinated greenhouse gases that have a significant impact on climate. Upon completion of the ratification process of the Kigali Amendment, it is envisaged to

²⁴ <https://www.kmu.gov.ua/news/uryad-shvaliv-cili-klimatichnoyi-politiki-ukrayini-do-2030-roku>

²⁵ The first NDC actually envisaged a 40% reduction in GHG emissions by 2030 from 1990 levels. The updated NDC increased the target to reduce GHG emissions to 65% of 1990 levels.

²⁶ https://unfccc.int/sites/default/files/NDC/2022-06/Ukraine%20NDC_July%2031.pdf

²⁷ <https://www.energy-community.org/legal/decisions.html>

²⁸ <https://mepr.gov.ua/povidomleniya-pro-oprylyudneniya-proyektu-rozporyadzhennya-kabinetu-ministriv-ukrayiny-pro-shvalennya-strategiyi-formuvannya-ta-realizatsiyi-derzhavnoyi-polityky-u-sferi-zminy-klimatu-na-period-do-203/>

²⁹ <https://mepr.gov.ua/povidomleniya-pro-oprylyudneniya-proyektu-zakonu-ukrayiny-pro-osnovni-zasady-derzhavnoyi-klimatichnoyi-polityky/>

³⁰ Law of Ukraine "On Regulation of Economic Activities with Ozone Depleting Substances and Fluorinated Greenhouse Gases" No. 376-IX of December 12, 2019, <https://zakon.rada.gov.ua/laws/show/376-20#Text>

³¹ Order of the Cabinet of Ministers of Ukraine "On Approval of the National Environmental Action Plan for the period up to 2025" No. 443-p of April 21, 2021, <https://zakon.rada.gov.ua/laws/show/443-2021-%D1%80%D1%80#n12>

³² <https://mepr.gov.ua/povidomleniya-pro-oprylyudneniya-proyektu-zakonu-ukrayiny-pro-ratyfikatsiyu-popravky-do-monrealskogo-protokolu-pro-rechovyny-shho-rujnyut-ozonovyj-shar/>

develop and approve the Strategy for Reducing Emissions of Ozone Depleting Substances and Fluorinated GHGs, which should be done during 2024-25.

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 stage for them is a 10% reduction in consumption. There are 5 stages of consumption reduction for the following countries: (Stage 1 (2019) - 10%, Stage 2 (2024) - 40%, Stage 3 (2029) - 70%, Stage 4 (2034) - 80%, Stage 5 (2036) - 85%. Taking into account this schedule and the fact that Ukraine is scheduled to ratify the Kigali Amendment in 2024, the HFC reduction target will be set at 40%. For Ukraine, the baseline consumption level is calculated based on the average HFC production/consumption in 2011, 2012 and 2013 plus 15% of the HCFC baseline production/consumption. The baseline for Ukraine is currently being calculated, from which the reduction of HFC use will be carried out.

Decarbonization (development of renewable energy sources)

Increasing the share of RES in the energy balance, development of distributed generation and energy storage facilities are among the main priorities of the state policy in the electricity sector, as defined by the Energy Strategy of Ukraine (ESU) for the period up to 2050, approved by the Cabinet of Ministers of Ukraine on April 21, 2023, No. 373³³.

The policies and measures of the state policy in the area of decarbonization are presented in detail in Section 3.1.

Energy efficiency

The ESU defines self-sufficiency and consumption efficiency as the primary strategic goal. The main document establishing the legal framework for energy efficiency policy is the Law of Ukraine "On Energy Efficiency"³⁴. This law transposed into national legislation most of the provisions of Directive 2012/27/EU of the European Parliament and of the Council of October 25, 2012 on energy efficiency, amending Directives 2009/125/EC and 2010/30/EU and repealing Directives 2004/8/EC and 2006/32/EC (Directive 2012/27/EU). The Law of Ukraine "On Energy Efficiency" defines the legal, economic and organizational framework for relations arising in the field of energy efficiency in the production, transportation, transmission, distribution, supply and consumption of energy. This legal act provides for the preference to be given to energy efficiency measures that reduce energy demand in the development of regulations, strategic documents of state policy and decision-making on financing measures for the development of the integrated energy system of Ukraine, gas infrastructure facilities or heat supply facilities, if energy efficiency measures are more economically feasible (the principle of "energy efficiency first"). Certain provisions of Directive 2012/27/EU have been implemented in Ukrainian legislation by special laws. For example, the issues of commercial metering of heat and water are regulated by the Law of Ukraine "On Commercial Metering of Heat and Water Supply"³⁵. State financing of energy efficiency measures in the residential sector is provided by the Energy Efficiency Fund, which operates in accordance with the Law of Ukraine "On the Energy Efficiency Fund"³⁶.

Directive 2010/31/EU of the European Parliament and of the Council of May 19, 2010 on the energy performance of buildings (Directive 2010/31/EU) was transposed by the Law of Ukraine "On Energy

³³ <https://zakon.rada.gov.ua/laws/show/373-2023-%D1%80#Text>

³⁴ <https://zakon.rada.gov.ua/laws/show/1818-20#Text>

³⁵ <https://zakon.rada.gov.ua/laws/show/2119-19#Text>

³⁶ <https://zakon.rada.gov.ua/laws/show/2095-19#Text>

Efficiency in Buildings"³⁷. This law provides for the establishment of minimum requirements for the energy efficiency of buildings, energy certification of buildings and inspection of engineering systems, and certification of energy auditors of buildings. In December 2023, the Government approved the Long-Term Strategy for Thermal Modernization of Buildings until 2050 by the Decree of the Cabinet of Ministers of Ukraine No. 1228 of 29.12.2023.³⁸

The Law of Ukraine "On Combined Heat and Power Generation (Cogeneration) and Use of Waste Energy Potential" regulates relations related to the specifics of production, transmission, distribution and supply of electricity and heat from cogeneration plants.

In order to fully fulfill Ukraine's obligations under the Association Agreement between Ukraine and the European Union and the Treaty establishing the Energy Community, Ukraine is implementing energy labeling and eco-design requirements for energy-consuming products in accordance with EU legislation. Regulation (EU) No. 2017/1369 of the European Parliament and of the Council of July 04, 2017 establishing a framework for energy labeling and repealing Directive 2010/30/EU was transposed into national law by the Technical Regulation on Energy Labeling of Energy Consuming Products approved by Order of the Ministry of Energy of Ukraine No. 164 of 27.04.2022.³⁹, Directive 2009/125/EC of the European Parliament and of the Council of October 21, 2009, establishing a system for determining ecodesign requirements applicable to energy-consuming products was transposed by the Technical Regulation on the establishment of a system for determining ecodesign requirements for energy-consuming products, approved by the Cabinet of Ministers of Ukraine No. 804 of 03.10.2018.⁴⁰ There are 24 technical regulations that establish requirements for the ecodesign of certain groups of energy-consuming products and 15 technical regulations on energy labeling.

The main barriers to the implementation of energy efficiency measures are distortions in tariff policy, lack of qualified personnel to identify and implement projects, limited opportunities to attract financing and the high cost of funds raised, and the lack of sustainable state co-financing of energy efficiency measures.

Energy security

The key documents that define both goals and policies in terms of deepening the diversification of sources and routes of energy supply from third countries with the potential goal of reducing dependence on energy imports are the National Economic Strategy for the period up to 2030⁴¹ (NES) and the Energy Strategy of Ukraine for the period up to 2050 (ESU)⁴². The former defines the overall goal of ensuring diversification of energy supplies at the level of no more than 30% from a single supplier, while the latter is a supporting strategy for diversification, stimulation of domestic production and development of further value-added elements (in particular, oil and gas processing). It is worth noting that the ESU, aiming at comprehensive integration with the EU energy markets and ensuring the efficient functioning of domestic energy markets, defines the building of an export-oriented energy industry as one of its indicators.

The National Security Strategy⁴³ declares among its goals the need to diversify sources and routes of energy supply. The Energy Security Strategy envisages among its priorities the stimulation of import substitution, in particular through the development of bioenergy, wind energy, and a reasonable increase in energy

³⁷ <https://zakon.rada.gov.ua/laws/show/2118-19#Text>

³⁸ <https://zakon.rada.gov.ua/laws/show/1228-2023-%D1%80#Text>

³⁹ <https://zakon.rada.gov.ua/laws/show/z0615-22#Text>

⁴⁰ <https://zakon.rada.gov.ua/laws/show/804-2018-%D0%BF#Text>

⁴¹ <https://zakon.rada.gov.ua/laws/show/179-2021-%D0%BF>

⁴² <https://zakon.rada.gov.ua/laws/show/373-2023-%D1%80#Text>

⁴³ <https://zakon.rada.gov.ua/laws/show/392/2020#Text>

production. Specifically for the nuclear industry, the Concept of the State Target Economic Program (with a planning horizon until 2026) and the program itself (for the period until 2028) have been developed.

With regard to increasing the flexibility of the national energy system, the above-mentioned strategies include the introduction of highly maneuverable capacities to ensure the balance reliability of the IPS of Ukraine and support further integration of RES.

In terms of eliminating restrictions or interruptions in energy supply in order to increase the resilience of energy systems, the main policies and measures include the ESU, the Law of Ukraine "On Critical Infrastructure"⁴⁴, the Cybersecurity Strategy of Ukraine⁴⁵, the Law of Ukraine "On the Basic Principles of Ensuring Cybersecurity of Ukraine"⁴⁶, and certain decisions of the NSDC. The target is to ensure physical, engineering, technical and cyber defense of 100% of facilities. It is separately stipulated that in the context of a full-scale invasion of Ukraine by the Russian Federation, the protection of critical infrastructure facilities (CIF) is a priority.

The Laws "On the Electricity Market"⁴⁷, "On the Natural Gas Market"⁴⁸, and relevant bylaws regulate measures to ensure security of supply, including the responsibility of the Ministry of Energy to approve rules on security of supply of natural gas and electricity and the National Action Plan, which are binding on all market participants, as well as to monitor security of supply (for electricity - jointly with the Regulator, the transmission system operator and other relevant

Another group of policies is the formation and preservation of energy reserves, such as natural gas, coal, and fuel oil. Most of them are regulated by law. At the end of 2022, amendments to the Law on the Natural Gas Market defined the obligation of the Ministry of Energy to calculate the target level of filling gas storage facilities and to formulate a schedule for filling gas storage facilities. In 2023, the Law "On Minimum Oil and Oil Products Reserves" was adopted⁴⁹, which provides for the creation of reserves for 90 days of net imports or 61 days of domestic consumption. The creation and maintenance of the minimum required reserves of coal and reserve fuel (fuel oil) is regulated by the Procedure for Formation of the Forecast Electricity Balance of the IPS of Ukraine⁵⁰ and the Rules on Security of Electricity Supply⁵¹.

Energy market (electricity)

The policies and measures implemented by Ukraine in terms of market development are determined by such key priorities as further liberalization of the electricity market and deeper integration of the energy systems and markets of Ukraine and the EU. In terms of integration, Ukraine seeks to strengthen cross-border electricity connections with ENTSO-E countries through the implementation of projects of common interest. In particular, the ESU defines the goal of developing interconnectors and reaching 6 GW of transmission capacity with ENTSO-E countries by 2032.

The expansion of cross-border infrastructure, combined with the integration of spot and balancing electricity markets, will improve the competitiveness and liquidity of the domestic market by intensifying

⁴⁴ <https://zakon.rada.gov.ua/laws/show/1882-20>

⁴⁵ <https://zakon.rada.gov.ua/laws/show/447/2021#Text>

⁴⁶ <https://zakon.rada.gov.ua/laws/show/2163-19>

⁴⁷ <https://zakon.rada.gov.ua/laws/show/2019-19#Text>

⁴⁸ <https://zakon.rada.gov.ua/laws/show/329-19#Text>

⁴⁹ <https://zakon.rada.gov.ua/laws/show/3484-IX#Text>

⁵⁰ <https://zakon.rada.gov.ua/laws/show/z1312-18#Text>

⁵¹ <https://zakon.rada.gov.ua/laws/show/z1076-18#n17>

international electricity trade, creating better conditions for attracting systemic investment in the development of the sector and the introduction of new energy technologies.

Ukraine is implementing the policy of introducing European rules for international electricity trade through the use of joint auctions for the allocation of available capacity of interstate networks, including the organization of auctions on the joint European auction platform Joint Allocation Office (JAO). The next stage of integration is the full-fledged unification of electricity spot markets (day-ahead market and intraday market), which involves the use of implicit auctions for the allocation of capacity of interstate measures.

The market transformation will be carried out in the direction of a balanced combination of the advantages of "big" and "small" local energy. The priority is to develop distributed generation based on renewable energy sources in combination with flexible energy capacities and technologies to ensure resource adequacy, flexibility, operational security and sustainability of the power system and market. In the country's electricity balance by 2030, Ukraine aims to achieve at least 25% of electricity generated from renewable sources.

To increase the resilience of the energy system and market competitiveness, Ukraine is implementing policies to develop distributed generation (primarily based on renewable energy sources and energy storage facilities) and smart grids. These policies envisage more active participation of consumers in the market and the use of new market models, such as self-generation (self-consumption), aggregation, demand management, energy cooperatives, etc.

The development of smart grids should take place within the framework of the Concept for the Implementation of Smart Grids in Ukraine by 2035.⁵² As part of their five-year distribution system development plans, electricity distribution system operators (DSOs) develop grid digitalization measures and include relevant projects in their investment programs, which are subject to approval by the Regulator. The programs are financed within the framework of electricity distribution tariffs, which for the vast majority of DSOs are applied on the basis of incentive regulation (RAB tariffs).

In 2019, Ukraine carried out a fundamental reform of the wholesale and retail segments of the electricity market, moving from a single buyer model to a competitive market model based on the EU model by introducing an appropriate institutional environment and structural organization of the market as provided for in the EU Third Energy Package. Currently, Ukraine is working on creating an institutional environment for the implementation of the provisions of the EU's Fourth Energy Package (Clean Energy Package). In addition to the above, the basic policies and measures for the development of the electricity market include:

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

To introduce market-based pricing, electricity prices for households will be gradually brought to market-based levels, while protecting vulnerable consumers and developing competition in the retail market.

⁵² <https://zakon.rada.gov.ua/laws/show/908-2022-%D1%80#Text>

Energy-poor consumers will be protected through targeted monetized support and incentives to improve energy efficiency.

Energy market (gas)

In accordance with the NES, ESU, taking into account the requirements of the Law of Ukraine "On the Natural Gas Market", other laws, as well as Ukraine's international obligations, the development of oil and gas infrastructure is aimed at achieving the following goals:

- Ensure sufficient connectivity with the EU/European Energy Community for natural gas exports/imports, as well as develop oil transportation system connections;
- Modernization in line with the requirements to improve energy efficiency and reduce emissions of harmful substances and optimize oil and gas infrastructure facilities;
- Potential re-profiling of certain oil and gas infrastructure facilities for new activities as part of decarbonization.

Accordingly, the main policies and measures aimed at achieving these goals are to promote the development of new interconnections, improve energy infrastructure planning procedures and ensure its involvement in future EU energy markets, optimize existing oil and gas infrastructure, and build a regulatory framework for new energy markets.

In terms of integration of the natural gas, renewable and low-carbon gas markets, the main objectives are to integrate with the EU energy markets, ensure production of biomethane and natural gas, the completeness and reliability of gas metering, and introduce market-based energy pricing for all consumers while protecting those in need of state support.

Accordingly, the main policies and measures aimed at achieving these goals should be highlighted:

- Ensuring the possibility of exporting gas, both natural gas and biomethane;
- Addressing technical and safety issues related to gas supplied to gas networks;
- Introduction of metering in energy units;
- Ensuring effective management of the gas distribution systems;
- Setting up effective balancing rules;
- Ensuring 100% metering;
- Creation of a functioning commercial accounting system.

These policies and measures are described in more detail in Section 3.

In terms of reducing energy poverty, the task is to legislatively define this concept, determine the methodology for calculating the specific circle of people in energy poverty, and define a clear list of measures to reduce energy poverty in Ukraine. At the same time, the existing system of direct subsidies should be strengthened, taking into account the goals of liberalizing energy prices for all categories of consumers.

iii. Key issues of cross-border importance

1) Some issues of financing new capacities with the involvement of the EU:

- **Financing of gas and oil projects:**

The new TEN-E Regulation no longer provides for the financing of natural gas and oil projects from the funds of the Connecting Europe Facility. At the same time, both this NECP and the NECPs of the EU member states show that the need for natural gas and oil will not completely stop by 2030, and construction or other additional measures for certain oil and gas infrastructure facilities are needed to avoid supply disruptions. The relevant projects are described in Section 3.

Accordingly, it is necessary to agree on mechanisms for financing such projects, which are necessary from the point of view of security of supply and the vital activity of the population and the economy.

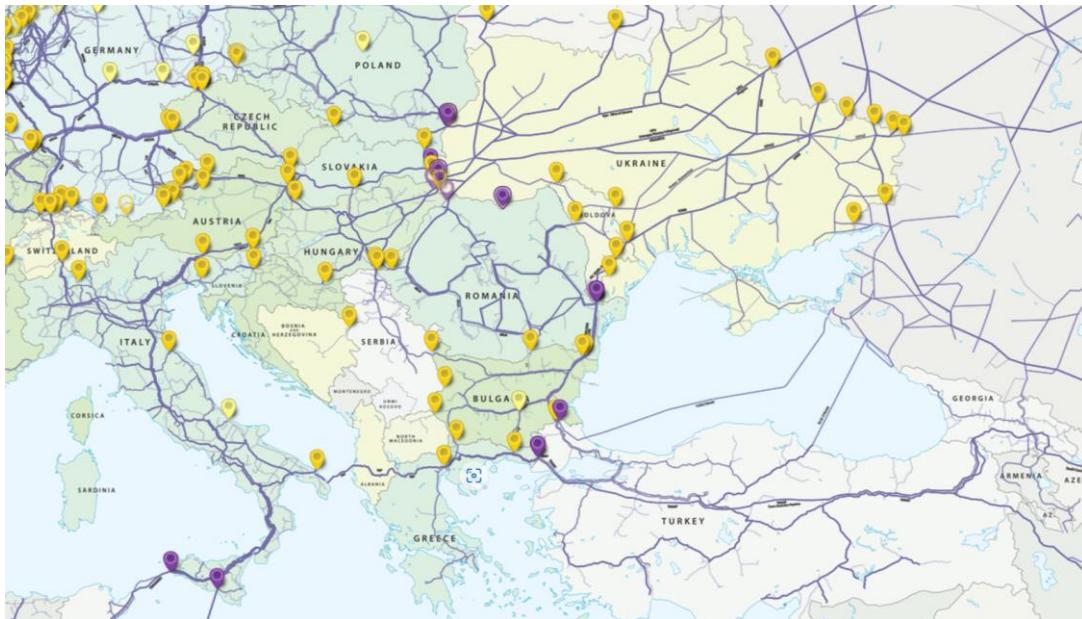
- **Financing of hydrogen projects:**

In March 2023, the European Commission provided details of the creation of the European Hydrogen Bank, the idea of which was announced in September 2022⁵³. The proposed activities of this financial mechanism include the provision of financing in the form of a "green" premium 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, applies only to future hydrogen producers within the European Economic Area (not including Ukraine)⁵⁴. It is expected that the H2Global project platform will be used to conduct support auctions for hydrogen imports to the EU.

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

2) Main issues related to infrastructure projects of other countries (natural gas):

After the adoption of the RePowerEU plan, which envisaged a gradual phase-out of Russian gas as soon as possible and preferably by 2027, the map of gas flows and gas infrastructure began to change dramatically. Moreover, in the period 2025-2030, no natural gas transit through Ukraine from the Russian Federation to the EU and the Energy Community is expected⁵⁵. In terms of natural gas infrastructure development, Ukraine is heavily dependent on infrastructure projects of other countries.



⁵³ COM/2023/156 final

⁵⁴ https://climate.ec.europa.eu/system/files/2023-08/innovationfund_pilotauction_termsandconditions_en.pdf

⁵⁵ <https://www.radiosvoboda.org/a/news-halushchenko-ukraina-rosiia-prodovzhennia-tranzitu-hazu/32552079.html>

Source: ENTSOG Transparency Platform

In general, there are several areas in which important projects (both necessary and alternative) are being developed in Ukraine:

- 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 independence, natural gas transiting through Ukraine has been delivered to consumers in Hungary, Slovakia, as well as Romania, Bulgaria, and through Ukraine to Greece, Serbia, and Turkey. With the construction of the BlueStream (2005) and TurkStream (2019) pipelines, gas from the Russian Federation is being transported directly to Turkey. Given the termination of transit through Ukraine in 2025, according to the most up-to-date information on this corridor, a dramatic change in gas flows from south to north is expected due to a significant increase in regasification capacity, as well as increased opportunities for additional gas volumes from other sources. At the same time, new gas production in Turkey is likely to 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 bcm/year, which is 5 times higher than the current consumption of this country. Greece is also home to the TAP gas pipeline, the capacity of which is proposed to be increased to 20 billion m³/year. In addition, it is proposed to build the new EastMed and Poseidon projects in Greece: the first one is to connect new sources of gas supply to the EU from Cyprus and the Middle East; the second one will provide an underwater connection between Greece and Italy. Both new projects are included in the TYNDP 2022 with an initial commissioning date of 2025 (final commissioning for the Poseidon project is expected by 2028; however, due to a number of political reasons, the projects may take longer to implement). The EastMed project is included in the PCI/PMI list of projects under number 15.2.⁵⁶ The capacity of the projects is initially 11-12 bcm with the possibility of increasing to 20 bcm/year.

To the north, Greece is connected to Bulgaria at two interconnection points. In October 2022, the IGB gas pipeline with a capacity of 3 billion m³/year started operating at one of them (with the possibility of expanding to 5 billion m³/year, which, according to Bulgartransgaz, is expected to be in place by 2025). The option of expanding the capacity of another interconnection point Kulata/Sidirokastron is also being considered (according to Bulgartransgaz, it is expected to be completed in 2026); for this purpose, it is also necessary to strengthen the Bulgarian GTS (currently, the relevant project TRA-N-1140 is included in ENTSOG TYNDP 2022 with a deadline of 2025).

Like Greece, Bulgaria expects to increase its role as a gas transit country. In particular, gas coming to Bulgaria from Greece and Turkey will be transported to Serbia,⁵⁷ Romania, and through them to other countries. In addition to Greece, gas can also enter Bulgaria directly through Turkey thanks to a recently signed contract with the Turkish state-owned company BOTAS. The terms of this agreement are confidential, but according to available information, it should allow the Bulgarian side to access 1.5 bcm/year of regasification capacity in Turkey, which BOTAS is supposed to deliver to the Bulgarian border. Given Bulgaria's insignificant gas consumption (even with the prospect of increasing), the available gas resource will exceed its needs, and thus is intended for transit to other countries through Serbia or Romania.

⁵⁶ 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.

⁵⁷ In December 2023, the gas pipeline between Bulgaria and Serbia was commissioned, allowing for a two-way gas flow of 1.8 bcm/year (in case of strengthening the capacity of the Bulgarian GTS, the capacity of this pipeline can be expanded to 2.4 bcm/year).

The latter covers about 70% of its own needs through its own production, which is planned to be gradually increased, so significant volumes of gas can be expected to leave Romania for transportation to other countries. Bulgaria is connected to Romania by gas pipelines that were used primarily for gas transit from Russia (Kardam/Negru Voda 1, 2, 3); by 2026, it is planned to strengthen the Bulgarian GTS to increase the capacity of gas flow to Romania with a volume of 4.7 bcm/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 transmission networks should be ensured, and cooperation with the countries of Northwest, Southern Europe and other regions should be developed to jointly implement projects to diversify gas supplies to Central and Eastern Europe. In this context, in January 2024, Ukraine and Moldova joined the Memorandum on the Vertical Corridor, which provides for coordination at the operator level with the participation of operators from Greece, Bulgaria, Romania, Hungary, and Slovakia, to ensure gas flows from the south to the north of Europe (using the capacity of the Trans-Balkan gas pipeline).⁵⁸

Regarding the Germany-Poland corridor:

Since independence, natural gas transiting through Ukraine has been delivered to consumers in Poland and Germany via Ukraine. After the launch of the Yamal (2006) and Nord Stream (2011) pipelines, gas from the Russian Federation began to be supplied directly to these countries. At the same time, part of the hybrid aggression of the Russian Federation was the reduction of gas transportation through the territory of Ukraine and Poland.

Given the termination of transit through Ukraine at the end of 2024, according to the most up-to-date information on this corridor, a steadily large volume of gas is expected to arrive (given Germany's significant domestic needs) due to an increase in regasification capacity in Germany and Poland, and thus an increase in the potential for gas movement from north to south. Thus, according to the German Ministry for Economic Affairs and Climate Protection, in 2025-2030, the capacity of all German LNG terminals will increase from 37 billion m³ to 54 billion m³⁵⁹.

Poland has 2 projects planned: one is to expand the regasification capacity of the LNG terminal in Świnoujście from the current 6.2 to 7.5 billion m³; the second is to launch the FSRU near Gdańsk by 2027. Both projects are included in the TYNDP 2022 (LNG-F-272; LNG-A-947).

For Ukraine, it is important to ensure a sufficient connection between the north and south of Poland to obtain an additional source of gas supply and export. At the same time, historically, Poland's GTS has had problems with ensuring the movement of gas from north to south (in this regard, the TRA-F-245 project with an expected end date of implementation by 2028 is included in the TYNDP 2022).

Regarding the Italy-Austria-Slovakia corridor:

Since independence, natural gas transiting through Ukraine has also been delivered to consumers in Austria and Italy. Given the termination of transit through Ukraine at the end of 2024, according to the most up-to-date information, this corridor is expected to dramatically change flows from south to north, which will strengthen Italy's role as a gas transit country between Africa and 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, this need is expected to be covered by new domestic production, pipeline and liquefied gas supplies, as well as energy savings and the replacement of natural gas with biomethane. This requires, among other things, strengthening the Italian domestic network through the implementation of the Linea Adriatica project. Currently, gas exports to Austria can only take place through the Tarvisio/Arnoldstein interconnection point. Special attention should be paid to the needs of

⁵⁸ <https://tsoua.com/news/spivpraczya-shhodo-vertykalnogo-korydoru-poslyuvetsya-zavdyaky-pidpysannyu-memorandumu-pro-vzayemozuminnyya-shhodo-uchasti-moldovy-slovachchyny-ta-ukrayiny/>

⁵⁹ Ibid.

Austria, which still needs to strengthen its own measures to abandon Russian gas. It is possible to use the Trans-Balkan gas pipeline (as part of the Vertical Corridor) to meet Austria's needs for additional gas volumes, including using the additional advantages of Ukrainian underground gas storage facilities.

3) Main issues related to infrastructure projects of other countries (hydrogen):

In general, no significant volumes of cross-border hydrogen transportation are expected until 2030. At the same time, after 2030, both the EU and individual member states predict that this resource will be imported from other countries. Ukraine is competing for this opportunity with countries in North Africa and the Middle East.



Source: European Hydrogen Alliance with reference to the European Commission

The delivery of hydrogen to the EU and its transportation to consumers will require the provision of adequate infrastructure. The Central European Hydrogen Corridor (CEHC) project, in which GTSOU is a participant, is reflected in the Regional Gas Investment Plan for Northwest Europe of December 2022⁶⁰ and in the vision of hydrogen networks developed by the European Hydrogen Backbone (EHB) initiative, in which GTSOU has also been a partner since April 2022⁶¹.

⁶⁰ https://www.eugastsogrip.eu/wp-content/uploads/2022/12/entsog_GRIP_NW_2022_221208.pdf

⁶¹ <https://ehb.eu/#partners>



Source: European Hydrogen Backbone Maps

In addition, planning processes for future hydrogen infrastructure are taking place within ENTSOG, in particular during the preparation of the TYNDP (which currently covers hydrogen projects)⁶². It should be borne in mind that inclusion in the TYNDP opens the way for receiving grants from the Connecting Europe Facility for which Ukraine has recently also been competing.⁶³



Source: ENTSOG TYNDP 2022 Map

⁶² ACER, Opinion No. 06/2023 of July 14, 2023 on the ENTSOG draft Ten-Year Network Development Plan 2022, para. 26.

⁶³ https://ec.europa.eu/commission/presscorner/detail/en/ip_23_3061

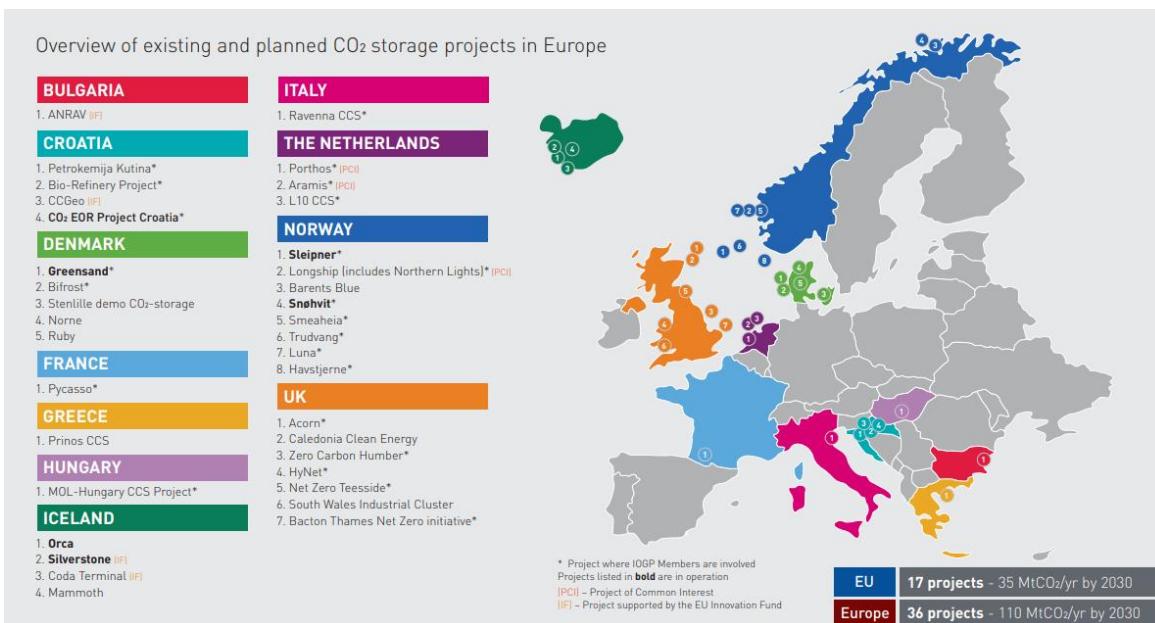
Thus, the analysis of TYNDP 2022 shows that operators in other countries near Ukraine are planning to build hydrogen infrastructure to the borders with Ukraine:

- HYD-N-1165 "HU hydrogen corridor HU/UA", connection to Hungary (Berehdaros - Berehove);
- HYD-N-730 "Coroi - Medieșu Aurit modernization for H2 transmission", connection to Romania (Tekovo);
- HYD-N-640 "Isaccea - Jupa modernization for H2 transmission", connection to Romania (Orlovka);
- HYD-N-756 "Negru Voda - Isaccea modernization for H2 transmission", connection to Romania (Orlovka) (this is the Trans-Balkan gas pipeline).

At the same time, these projects are not included in the latest list of PCI/PMI projects approved by the European Commission at the end of 2023. In addition, during the consultations on the draft of this NECP, Poland expressed its intention to develop cross-border hydrogen infrastructure (although the relevant projects are not yet in TYNDP 2022 and the list of PCI/PMI projects of the European Commission).

4) The main issues related to infrastructure projects of other countries (carbon dioxide, hereinafter referred to as CO2):

The EU is considering a target of 50 million tons of CO2 storage capacity by 2030. As of December 2023, 22 projects related to CO2 capture, storage and utilization (CCUS) technologies are being developed within the perimeter of the EU Innovation Fund⁶⁴. In addition, the latest decision of the European Commission included 14 CCUS projects in the list of PCI/PMI projects⁶⁵. These projects form part of the picture of CCUS projects in Europe.



Source: IOGP⁶⁶

⁶⁴ https://climate.ec.europa.eu/eu-action/eu-funding-climate-action/innovation-fund/innovation-fund-projects_en

⁶⁵ 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.

⁶⁶ <https://iogpeurope.org/wp-content/uploads/2023/10/Map-CO2-Storage-Projects-in-Europe.pdf>

On February 06, 2024, the European Commission adopted the Strategy for Industrial Carbon Management,⁶⁷ which defines not only the potential for these technologies to contribute to emission reductions, but also future measures to build a pan-European infrastructure. According to this strategy, the recognition of CO₂ storage facilities outside the EU is possible in the presence of an EU-synchronized ETS or under conditions of safe and environmentally friendly CO₂ storage that leads to emission reductions.

iv. Administrative structure for the implementation of national energy and climate policies

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

- The President of Ukraine (in terms of exercising constitutional powers to ensure national security, implementing the strategic course of the state towards Ukraine's full membership in the EU and NATO);
- The Verkhovna Rada of Ukraine (in terms of adopting laws, the state budget, approving national programs of economic, scientific and technical development, and environmental protection);
- The Cabinet of Ministers of Ukraine (as the supreme body in the system of executive authorities that directs and coordinates the work of ministries and other executive authorities);
- The Ministry of Economy of Ukraine (MEDT);
- The Ministry of Energy of Ukraine (MOE);
- The Ministry of Environmental Protection and Natural Resources of Ukraine (MEPR);
- The Ministry of Community Development, Territories and Infrastructure of Ukraine (Ministry of Infrastructure);
- The National Energy and Utilities Regulatory Commission (NEURC, the Regulator);
- The State Agency on Energy Efficiency and Energy Saving of Ukraine (SAEE), the State Service of Geology and Subsoil of Ukraine (Derzhgeonadra), the State Energy Supervision Inspectorate of Ukraine (Derzhenergonadzor), and other central executive authorities;
- Operators of infrastructure facilities and individual energy market players;
- Local governments.

⁶⁸**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 the state policy of 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.

The powers of the Ministry of Economy as a central executive body involved in the formation and implementation of state policy in the field of public procurement, including playing an important role in

⁶⁷ EUR-Lex - 52024DC0062 - EN - EUR-Lex (europa.eu)

⁶⁸ <https://zakon.rada.gov.ua/laws/show/459-2014-%D0%BF#Text>

the implementation of energy efficient procurement, are important. The Ministry of Economy is authorized to determine the acceptable energy efficiency classes for the procurement of energy-consuming products.

Among other things, the Ministry of Economy plays a key role in coordinating efforts to bring the national system of technical regulation and national standardization in line with EU legislation and European and international standards. The Ministry of Economy also analyzes the state of competitiveness and resource efficiency of industries, develops and coordinates measures to improve their level.

The Ministry of Energy 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 policy in the electricity, nuclear, industrial, coal, peat, oil and gas and oil and gas processing complexes, the formation and implementation of state policy in the field of renewable energy sources and alternative gas fuels and in the field of supervision (control) in the electricity and heat supply sectors.⁶⁹

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 certain entities in the natural gas and electricity markets, as well as certain gas and electricity infrastructure facilities, including the gas transmission system (GTS) and electricity transmission system, gas distribution systems (GDS) and electricity distribution systems, and underground gas storage facilities (UGS).

⁷⁰**The Ministry of Ecology** 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 policy in the field of environmental protection, state policy in the field of forestry and hunting, the formation of state policy in the field of geological exploration and rational use of subsoil, the implementation of state supervision (control) in the field of environmental protection, rational use, reproduction and protection of natural resources, and the

It should be noted that there is no framework legislation in Ukraine that defines the role and powers of government agencies on climate change. The main functions are assigned to the Ministry of Ecology, with some functions assigned to other central executive bodies. Among other things, the Ministry of Ecology ensures the formation and implementation of state policy in the field of regulation of ozone-depleting substances and fluorinated greenhouse gases, protection of the ozone layer and prevention of global warming, climate change, and implementation of the requirements of the UN Framework Convention on Climate Change, the Kyoto Protocol to it, and the Paris Agreement, including regulatory and legal regulation (develops drafts, issues regulations within its authority). Other bodies involved in climate policy are the Ministry of Energy, the Ministry of Agrarian Policy, and the State Emergency Service.⁷¹

Thus, the Government's plans to create an effective **climate governance architecture** (as a system of principles, rules and processes for formulating and implementing climate policy) require a clear division of functions and powers of government agencies.

The State Service of Geology and Subsoil of Ukraine (**Derzhgeonadra**) is a 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, is the authorized body for the implementation of production sharing agreements⁷².

⁶⁹ <https://zakon.rada.gov.ua/laws/show/507-2020-%D0%BF>

⁷⁰ <https://zakon.rada.gov.ua/laws/show/614-2020-%D0%BF#Text>

⁷¹ <https://rac.org.ua/uploads/content/646/files/cgainsititutionalframeworkukr.pdf>

⁷² <https://zakon.rada.gov.ua/laws/show/1174-2015-%D0%BF#Text>

The NEURC is a permanent collegial central executive body with a special status that carries out state regulation, monitoring and control over the activities of business entities in the energy and utilities sectors⁷³. The main tasks of the Regulator are:

- 1) ensuring the efficient functioning and development of markets in the energy and utilities sectors;
- 2) promoting the effective opening of energy and utilities markets to all consumers and suppliers and ensuring non-discriminatory access to networks/pipelines for users;
- 3) promoting the integration of the electricity and natural gas markets of Ukraine with the relevant markets of other states, in particular within the Energy Community, cooperation with the Energy Community Regulators Council, the Energy Community Secretariat and national energy regulators of other states;
- 4) ensuring the protection of the rights of consumers of goods and services in the energy and utilities sectors to receive these goods and services of adequate quality in sufficient quantities at reasonable prices;
- 5) facilitating cross-border trade in electricity and natural gas, ensuring investment attractiveness for infrastructure development;
- 6) implementation of price and tariff policy in the energy and utilities sectors;
- 7) promoting the implementation of energy efficiency measures, increasing the share of energy production from renewable energy sources and environmental protection;
- 8) creating favorable conditions for attracting investment in the development of energy and utilities markets;
- 9) promoting competition in the energy and utilities markets;
- 10) other tasks provided for by law⁷⁴.

⁷⁵**The Ministry of Infrastructure** 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 policy in the field of road, rail, sea and inland water transport, aviation transport and the use of the airspace of Ukraine, multimodal transportation, protection of critical infrastructure in the relevant sectors, in the field of state regional policy, development of local self-government, territorial organization of power and ad

It is important to note the correlation between the powers of the NEURC and the Ministry of Infrastructure in regulating the heat supply sector. The NEURC is responsible for state regulation, licensing and tariff setting for business entities engaged in heat production at thermal power plants, thermal power plants, nuclear power plants and cogeneration plants. The Ministry of Infrastructure is responsible for state regulation of heat production from other sources, transportation and supply of heat energy. Licensing for these activities is carried out by regional state administrations, and tariffs are set by local governments.

The Ministry of Infrastructure, together with the Ministry of Energy and the National Energy and Utilities Regulatory Commission, are the key bodies that should operationalize the principle of "energy efficiency first" and ensure its cross-cutting implementation.

⁷³ <https://zakon.rada.gov.ua/laws/show/1540-19#Text>

⁷⁴ <https://www.nerc.gov.ua/pro-nkrekp/osnovni-zavdannya-ta-funkciyi>

⁷⁵ <https://zakon.rada.gov.ua/laws/show/460-2015-%D0%BF#Text>

The State Agency on Energy Efficiency and Energy Saving of Ukraine is a central executive body, whose activities are directed and coordinated by the Cabinet of Ministers of Ukraine through the Vice Prime Minister for Reconstruction of Ukraine - Minister of Community, Territorial and Infrastructure Development, 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 to implement the state policy in the field of efficient use of fuel and energy resources, energy saving and alternative fuels; to ensure an increase in the level of energy efficiency in all sectors of the national economy. The SAE is responsible for the development and implementation of technical regulations based on the relevant EU legislation.

The Energy Efficiency Fund was launched in July 2018⁷⁶. The purpose of the Fund is to support government initiatives on energy efficiency, introduce incentives and support the implementation of energy efficiency measures, in particular in the residential sector, in line with the Paris Agreement, the European Union acquis and the Treaty establishing the Energy Community. **Local governments** play an important role, in particular in improving energy efficiency.

The State Inspectorate for Energy Supervision of Ukraine (**SAEE**) is a central executive body directed and coordinated by the Cabinet of Ministers of Ukraine through the Minister of Energy and implementing the state policy in the field of supervision (control) in the electricity and heat sectors, as well as in the natural gas market. The main tasks of the State Agency are: 1) implementation of the state policy, submission of proposals to the Minister of Energy to ensure the formation of the state policy, as well as organization and implementation of the state policy in the field of supervision (control) in the electricity and heat supply sectors, as well as in the natural gas market⁷⁷.

The natural gas market has a gas transmission system **operator** (GTS Operator of Ukraine LLC), which is responsible for the reliable and safe operation, maintenance and development of the state-owned GTS. GTSOU 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** (JSC Ukrtransgaz). The gas storage operator has been certified in 2023 in accordance with the requirements of Regulation (EC) No. 715/2009 (as amended in 2022).

The transmission system operator (TSO), NPC Ukrenergo, is a systemically important element in the electricity market and is responsible for the development of the transmission system, including interstate power 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 and technological management (dispatching) in the Integrated Power System (IPS) of Ukraine, is an operator of the balancing market, ancillary services market, commercial metering administrator and settlement administrator, and an operator of auctions for the allocation of interstate grid capacity.

The operator of the day-ahead and intraday electricity spot markets is Market Operator JSC, which is responsible for organizing the purchase and sale of electricity and settlements in these segments. To fulfill the functions of the **guaranteed buyer**, SE Guaranteed Buyer was created, which operates in three main areas: 1) procurement of electricity at the feed-in tariff, 2) implementation of PSO mechanisms to ensure public interests in the electricity market (in terms of RES development, provision of affordable electricity to the population and ensuring security of electricity supply during martial law) and 3) organization of auctions for renewable generation entities.

Natural gas and electricity are distributed by **gas distribution system operators** (GDS) and **distribution system operators** (DSO), respectively, which are natural monopolies and are subject to regulation by the Regulator, in particular in terms of licensing activities and fulfillment of license conditions, approval of

⁷⁶ It operates on the basis of the Law of Ukraine "On the Energy Efficiency Fund": <https://zakon.rada.gov.ua/laws/show/2095-19#Text>

⁷⁷ <https://zakon.rada.gov.ua/laws/show/77-2018-%D0%BF#Text>

system development plans and relevant investment programs, approval of tariffs for distribution services, quality control of services, etc.

Since the beginning of the full-scale invasion of Ukraine by the Russian Federation, significant changes have taken place in the management of these companies. In the spring of 2022, at the request of the State Bureau of Investigation⁷⁸, a court decision seized and transferred the corporate rights of 26 gas distribution system operators to the National Agency of Ukraine for Finding, Tracing and Management of Assets Derived from Corruption and Other Crimes (ARMA). By its Resolution No. 49-r dated 28.05.2022 "Certain Issues of Management of Assets Seized in Criminal Proceedings in Exceptional Cases", in order to prevent the risk of an emergency in the energy sector, the CMU approved the transfer of seized stakes to the management of the joint-stock company JSC Chornomornaftogaz "for the period until the risk of failure and/or interruption of the operation of assets, which may lead to emergencies, and until the completion of procedural measures". At the same time, the CMU Resolution dated 25.11.2022 "On Settlement of the Use of Gas Distribution Systems or Their Components" approved the proposal of the Ministry of Energy to conclude a model agreement approved by the Cabinet of Ministers of Ukraine dated 21.02.2017 No. 95 "On Ensuring the Effective Use of Gas Distribution Systems or Their Components", with LLC Gas Distribution Networks of Ukraine to conclude agreements for the operation of gas distribution systems or their components and to terminate in this regard the agreements for the operation of gas distribution systems or their components concluded with gas distribution system operators in accordance with the provisions of the said resolution. In this regard, Gas Distribution Networks of Ukraine LLC, a member of Naftogaz Group, received a license to carry out natural gas distribution activities dated 26.12.2022 No. 1839,⁷⁹, the territory of which is gradually increasing with the transfer of assets from the previous GDS operators.⁸⁰ At the same time, the licenses of the previous operators are suspended.⁸¹ At the same time, there are ongoing lawsuits challenging a set of these decisions.

A major player in the natural gas market, which operates in the retail and wholesale markets and performs a number of special duties to ensure the public interest, is the **Naftogaz Group**, which includes production companies (JSC Ukrgasvydobuvannya and PJSC Ukrnafta), supplying companies (Gas Supply Company Naftogaz of Ukraine LLC, Gas Supply Company Naftogaz Trading LLC, Gas Supply Company Naftogaz Teplo LLC), and NJSC Naftogaz of Ukraine as a wholesaler.

Naftogaz Group also includes JSC Ukrtransnafta, which is an **operator of main oil and oil product pipelines** based on a license for oil transportation by main pipeline, as well as transportation of oil products by main pipeline on the part of the Samara-Western Direction main oil product pipeline (as a manager)⁸².

1.3. Consultations and involvement of national and Union actors and their results

i. Involvement of the national parliament

⁷⁸ <https://dbr.gov.ua/news/dbr-peredalo-v-upravlinnya-armi-26-regionalnih-operatoriv-gazorozpodilchih-sistem>

⁷⁹ <https://www.nerc.gov.ua/acts/pro-vidachu-licenziyi-z-rozpodilu-prirodnogo-gazu-tov-gazorozpodilni-merezhi-ukrayini>

⁸⁰ <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>

⁸¹ For example, <https://www.nerc.gov.ua/acts/pro-zupinennya-diyi-licenziyi-z-rozpodilu-prirodnogo-gazu-vidanoyi-mikolayivgaz>

⁸² <https://www.nerc.gov.ua/news/ukrtransnafta-otrimalo-licenziyu-z-transportuvannya-naftoproduktiv-magistralnim-truboprovodom>

MPs representing different factions and groups of the Verkhovna Rada of Ukraine and working within the relevant committees of the Verkhovna Rada of Ukraine are planned to be involved in a public discussion after the draft NECP is published.

ii. Involvement of local and regional authorities

Representatives of local governments were involved in public online consultations on the NECP dimensions and on certain cross-sectoral issues (see below). Additional engagement is planned as part of the public discussion after the publication of the draft NECP.

iii. Consultations with stakeholders, including social partners, as well as engagement of civil society and the public

The main assumptions for modeling scenarios in the preparation of the NECP and a description of the main parameters of the modeling scenarios were agreed by the Ministry of Economy of Ukraine with the Ministry of Energy of Ukraine, the Ministry of Community Development, Territorial 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 on the approach to modeling within the NECP.

In the course of developing the NEC, the expert group conducted the following activities:

- working consultations with representatives of the Ministry of Environment on the goals and policies in the area of "decarbonization" (28.09.2023), CBAM and carbon pricing instruments (1.11.2023), the state of preparation of key documents for the "decarbonization" measurement (24.01.2024), decarbonization policies in the waste sector (23.01.2024);
- working consultations with representatives of the Ministry of Infrastructure on the goals, adopted and planned policies in the field of energy efficiency (09/28/2023);
- working consultations with representatives of the Ministry of Energy on renewable energy goals, policies and measures (in particular, biofuels development) and the development of the nuclear industry (12.10.2023), future hydrogen goals, policies and measures (15.12.2023), alignment with the updated draft 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);
- working consultations with infrastructure operators and major players in the relevant markets, in particular JSC Ukrgasvydobuvannya (11/21/2023), JSC Ukrtransnafta (11/22/2023), JSC Ukrtransgaz (11/29/2023), PrJSC NPC Ukrrenergo (11/30/2023), LLC GTS Operator of Ukraine (12/11/2023).

In addition, the following public online consultations were held on the NEC's dimensions and on certain cross-sectoral issues:

- "Energy Efficiency in Municipalities (11/29/2023, about 150 registered participants):

As part of the consultation, participants raised the issue of the lag in the development of secondary legislation. In particular, at the time of the consultation, the issue of developing local energy plans had not been regulated, the mechanism for local governments to access information from electricity and natural gas suppliers was noted as ineffective, and secondary legislation for the certification of energy auditors had not been prepared.

- "Energy Security (11/30/2023, about 110 registered participants);
- "Decarbonization: Development of Renewable Energy" (December 13, 2023, about 100 registered participants):

In the context of renewable gases, questions were raised about the negative impact of regulated prices and the ban on gas exports on the development of the industry, the difficulties of interacting with the DSOs during connection, the uncompetitive cost of connection and other problems that together can only reach 50-100 million m³ of biomethane by 2030, the need to adapt existing support mechanisms to small producers, and integration into the Union database.

- "Decarbonization: Integration of RES into energy systems and markets" (14.12.2023, about 70 registered participants):

In the context of renewable gases, the participants discussed the difficulties of connecting biomethane production facilities to DSOs, the need to determine the future of gas distribution networks, improve their condition, regulate the use of gas for production and technological costs, and ensure that costs are reflected in the tariffs of operators (including the GTS operator for the second regulatory period of 2025-2030).

- "Decarbonization: Policies and measures to reduce GHG emissions" (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):

In the context of the gas market, the participants discussed the need to cancel PSO and the moratorium on prices for consumers, as well as the separate development and analysis of the energy market for transportation, including such fuels as CNG and LNG.

- "Improving the energy efficiency of enterprises and energy companies" (18.01.2024, 115 registered participants):

Among the main areas requiring additional government efforts, participants noted the creation of financial support instruments for enterprises to implement energy efficiency measures.

- "Motor fuels market and its decarbonization (oil refining, imports, development of RES in transport)" (25.01.2024, about 75 registered participants):

The discussion emphasized the need for more systematic state attention to the issue of energy use in transport. The issues of developing alternative fuels (CNG, LNG), ensuring the preservation of minimum stocks of oil and oil products, and the obligation to mix fuels with components of biological origin were raised.

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

iv. Consultation with other Member States

The consultations are planned as part of a public discussion after the publication of the draft NECP. In addition, as part of the NECP preparation, a High Level Advisory Group (HLAG) was established with the participation of representatives of the European Union, the Energy Community Secretariat, and the G7 countries. During regular meetings, HLAG members were presented with the key goals, policies and measures of the NECP, key assumptions and preliminary modeling results, and discussed the main challenges to harmonizing energy and climate policies.

Official letters inviting comments and proposals to the NECP were sent to neighboring countries. Comments were received from Poland, as well as an invitation to hold bilateral talks from Moldova.

v. Repeatable process of interaction with the Commission

The European Commission and the Energy Community Secretariat were involved in the meetings of the High Level Advisory Group (HLAG).

In addition to other meetings, on 22.03.2024, a presentation of the NECP project was held in Brussels with the participation of representatives of the Government of Ukraine and representatives of the European Commission, in particular the Directorate-General for Energy (DG ENER), the Directorate-General for Neighborhood and Enlargement Negotiations (DG NEAR), the Directorate-General for Climate Change (DG CLIMA), and other stakeholders from the European Commission.

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 draft NECP. Representatives and structural units of the European Commission are also involved in the process on an ongoing basis for the purpose of informing and discussing.

1.4. Regional cooperation in the preparation of the plan

i. Elements subject to joint or coordinated planning with other Member States

By Decision 2022/02/MC-EnC⁸³, on December 15, 2022, the Ministerial Council of the Energy Community adopted the common energy and climate goals of the Contracting Parties until 2030. Among other things, the following goals were set for Ukraine:

- Reduced greenhouse gas emissions by 65% compared to 1990 levels to 309 million tons of CO2-eq;
- The share of renewable energy sources in the structure of gross final energy consumption is at least 27%;
- Primary energy consumption is not more than 91.47 million toe, final energy consumption - 50.45 million toe.

The Energy Community contracting parties should take a coordinated approach to implementing policies to reduce dependence on fossil fuels in the short term and achieve climate neutrality in their economies by 2050. At the same time, as for Ukraine, the goals should be reviewed at the meeting of the Energy Community Ministerial Council following the end of martial law in Ukraine.

All issues related to the construction, expansion, and legal provision of guaranteed access to cross-border infrastructure, including methane, oil, hydrogen, and electricity, require joint and coordinated solutions.

ii. Explanation of how the plan addresses regional cooperation

Where appropriate, the NECP describes regional cooperation measures. Among other things, this applies to cooperation in the development of the electricity transmission system and gas transportation system, in the regional integration of markets and trade development, in risk assessment and planning of response measures to energy supply crises, and in reducing emissions through the conclusion of bilateral cooperation agreements under Article 6 of the Paris Agreement.

⁸³ https://www.energy-community.org/dam/jcr:421f0dca-1b16-4bb5-af86-067bc35fe073/Decision_02-2022-MC_CEP_2030targets_15122022.pdf

2. NATIONAL GOALS AND TARGETS

2.1. The "Decarbonization" dimension

2.1.1. GHG emissions and removals

i. Elements defined in Article 4(a)(1)

Ukraine's updated Nationally Determined Contribution to the Paris Agreement, which the Government approved on July 30, 2021⁸⁴, has significantly strengthened⁸⁵ Ukraine's contribution to tackling global climate change. Thus, the document envisages a **65% reduction in Ukraine's total GHG emissions by 2030 compared to 1990 emissions**⁸⁶. The same goal is enshrined in the Decision of the Ministerial Council of the Energy Community No. 2022/02/MC-EnC⁸⁷.

The National GHG Emission Reduction Target of Ukraine covers all GHG emissions⁸⁸ and all sectors (energy, industrial processes and product use, agriculture, LULUCF, waste). Ukraine's commitments under the updated NDCs include the temporarily occupied territories, although information on economic activity and GHG emissions in these territories is not available (expert estimates). It is expected that the IER will be revised after the restoration of Ukraine's territorial integrity.

According to the National GHG Emissions Inventory for 1990-2018, Ukraine's GHG emissions (including LULUCF) in 1990 amounted to 882.9 million tons of CO₂-eq.⁸⁹. Accordingly, the goal of reducing GHG emissions by 65% from the 1990 level would mean setting emissions at 309 million tons of CO₂-eq in 2030.

According to the GHG Emissions Inventory for 1990-2021⁹⁰, GHG emissions amounted to 341.5 million tons of CO₂-eq (including LULUCF) in 2021. This is 62.5% less than in 1990, but 7.5% more than in 2020.

The development of the second IED of Ukraine is scheduled for 2025.

ii. If applicable, other national goals and targets under the Paris Agreement, as well as existing national strategies. If applicable in relation to the contribution to the Union-wide GHG emission reduction commitment, other goals and targets, including sectoral targets and adaptation targets, if available

The long-term goals of achieving climate neutrality are set out in two strategic documents of Ukraine. Thus, the Energy Strategy of Ukraine until 2050 (hereinafter referred to as the ESU), approved by the Cabinet of Ministers of Ukraine on April 21, 2023, No. 373-p, envisages **achieving climate neutrality of the energy sector of Ukraine by 2050**⁹¹. The National Economic Strategy for the period up to 2030 (NES)⁹² refers to the **need to achieve climate neutrality (for the economy as a whole) by 2060. In addition**, the draft Law

⁸⁴ <https://www.kmu.gov.ua/news/uryad-shvaliv-cili-klimatichnoyi-politiki-ukrayini-do-2030-roku>

⁸⁵ The first NDC actually envisaged a 40% reduction in GHG emissions by 2030 from 1990 levels. The updated NDC increased the GHG emission reduction target to 65% of 1990 levels.

⁸⁶ https://unfccc.int/sites/default/files/NDC/2022-06/Ukraine%20NDC_July%2031.pdf

⁸⁷ <https://www.energy-community.org/legal/decisions.html>

⁸⁸ Carbon dioxide - CO₂, methane - CH₄, nitrogen oxide (I) - N₂O, hydrofluorocarbons - HFC, perfluorocarbons - PFC, sulfur hexafluoride - SF₆, nitrogen trifluoride - NF₃.

⁸⁹ This reference value may be recalculated if the methodology is revised in the Intergovernmental Panel on Climate Change (IPCC) guidelines.

⁹⁰ <https://unfccc.int/ghg-inventories-annex-i-parties/2023>

⁹¹ <https://zakon.rada.gov.ua/laws/show/373-2023-%D1%80#Text>

⁹² <https://www.kmu.gov.ua/npas/pro-zatverzhennya-nacionalnoyi-eko-a179>

of Ukraine "On the Basic Principles of the State Climate Policy"⁹³ states that "the state climate policy of Ukraine is aimed at achieving climate neutrality of Ukraine by 2050." However, a political decision to revise the long-term goal of climate neutrality has not yet been made.

Ukraine has also made additional commitments to reduce methane emissions by joining the Global Methane Pledge initiative, which was announced during the UNFCCC Conference of the Parties 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 plan⁹⁴ on July 7, 2023 (see the description of the planned activities in Section 3.1).

The methane emissions reduction target is formulated as an expected result of the implementation of a number of tasks set out in the Action Plan - a **30% reduction in methane emissions by 2030 from 2020 levels**, as envisaged by the Global Methane Pledge initiative.

According to the GHG Emissions Inventory for 1990-2021⁹⁵, methane emissions amounted to 72 million tons of CO₂-ekB in 2020 and 71.5 million tons of CO₂-ekB , which is about 21% of Ukraine's total GHG emissions. Accordingly, a 30% reduction in emissions in this sector (21.6 million tons of CO₂-ekB .) 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 help reduce GHG emissions. Thus, in 2021, Ukraine joined the Powering Past Coal Alliance⁹⁶ during an international conference in Glasgow and announced a goal of phasing out coal in power generation by 2035. The ESU confirmed the previously announced plans, in particular, it stated that the **use of coal-fired generation will be reduced until it is completely decommissioned in 2035**. However, the feasibility of achieving this goal by 2035 will be assessed after the end of the full-scale invasion of Ukraine by the Russian Federation, taking into account the condition and available capacities that will remain in operation after the end of hostilities⁹⁷ .

In the transportation sector, strategic documents also set several important goals. For example, the National Transport Strategy of Ukraine for the period up to 2030⁹⁸ envisages a **30% reduction in specific fuel consumption per 10 tonne-kilometers by 2030**. According to the ESU, electricity consumption in the sector is expected to increase to 11% in 2032 due to the electrification of transport. In particular, the share of electric transport is expected to reach 15% in 2032. At the same time, a new transportation strategy is currently being developed that may set new targets.

In recent years, Ukraine has also begun to develop a national climate change adaptation policy. Thus, on October 20, 2021, the Government approved the Strategy for Environmental Security and Climate Change Adaptation until 2030⁹⁹ to improve environmental security, reduce the impacts and consequences of climate change in Ukraine.

⁹³ <https://mepr.gov.ua/povidomlennyayapro-oprylyudnennya-proyektu-zakonu-ukrayiny-pro-osnovni-zasady-derzhavnoyi-klimatichnoyi-polityky/>

⁹⁴ <https://zakon.rada.gov.ua/laws/show/607-2023-%D1%80#Text>

⁹⁵ https://unfccc.int/sites/default/files/NDC/2022-06/Ukraine%20NDC_July%2031.pdf

⁹⁶ A coalition of national and subnational governments, businesses and organizations working to promote the transition from coal-fired power generation to renewable energy sources.

⁹⁷ From the beginning of the full-scale aggression until the end of the autumn-winter period of 2022/2023, about 50% of the available generating capacities and transformer substations of the Ukrenergo transmission system were temporarily lost (damaged and occupied), <https://mev.gov.ua/sites/default/files/field/file/proekt-rozporiadzhennya.pdf>

⁹⁸ <https://zakon.rada.gov.ua/laws/show/430-2018-%D1%80#Text>

⁹⁹ <https://zakon.rada.gov.ua/laws/show/1363-2021-%D1%80#Text>

The energy sector has been identified as one of the socio-economic sectors that are vulnerable to climate change, as the expected consequences pose threats to the reliable energy supply of all types of consumers. In particular, the deepening of seasonal and daily changes in energy demand due to climate change will complicate the balancing of the Integrated Power System of Ukraine. In addition, extreme weather events may increase the accident rate of power grids.

One of the Strategy's goals is to **strengthen the adaptive capacity and resilience of social, economic and environmental systems to climate change**, which is achieved through a number of tasks and measures (see description in Section 1.2.ii).

2.1.2. Renewable energy

i. Elements set out in Article 4(a)(2)

National indicative targets for renewable energy (RES) are presented in the draft NRE NAP¹⁰⁰.

The draft NECP stipulates that the **share of energy produced from renewable energy sources in the structure of gross final energy consumption should be at least 27% in 2030**. The same target is also set in the Decision of the Ministerial Council of the Energy Community No. 2022/02/MC-EnC.¹⁰¹

The draft NERP does not take into account the temporarily occupied territories. It is assumed that after the termination or abolition of martial law on the territory of Ukraine and the restoration of its territorial integrity, the NECAP will be revised.

The draft NERP was developed before the full-scale invasion of Ukraine by the Russian Federation. During 2022, the document underwent coordination of proposals with ministries and central executive authorities 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 particular to take into account the devastating impact of the full-scale invasion of Ukraine by the Russian Federation on the energy sector of Ukraine. Accordingly, the Ministry of Energy plans to revise the draft NERP to align it with the goals and provisions of the ESU.

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

The national indicative target for RES in gross final energy consumption by 2030 in heating and cooling systems, electricity generation, and the transport sector is presented in Annex 2 of the draft NERP (see Table 2.1), in particular by sector:

- electricity sector - increasing the share of energy from renewable sources by 2 times - from 14% to 25%;
- heating and cooling - a 4-fold increase in the share of energy from renewable sources, from 9% to 35%;
- Increase the share of energy from renewable sources in the consumption of the transport sector by 5 times - from 3% to 14%.

¹⁰⁰ https://saee.gov.ua/sites/default/files/DraftNPDVE_2030_SAEE_21_09_2022.pdf

¹⁰¹ <https://www.energy-community.org/legal/decisio>

Table 2.1. National Indicative Target for Renewable Energy Sources in Gross Final Energy Consumption by 2030 in Heating and Cooling Systems, Electricity Generation, and Transport Sector (percentage)

The direction of using energy from renewable sources	2020 year	2021 year	2022 year	2023 year	2024 year	2025 year	2026 year	2027 year	2028 year	2029 year	2030 year
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
Transportation ⁽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: gross final consumption of energy 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 consumption of energy for heating and cooling.

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

3 Share of renewable energy in the transport sector: the 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 by the volume of gasoline, diesel, biofuels used by road and rail transport and electricity consumed by land transport.

4 The share of renewable energy in gross final energy consumption (determined without taking into account the normalization of electricity produced by wind and hydroelectric power plants (with 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 plans to use to achieve the overall and sectoral renewable energy trajectories from 2021 to 2030, including the expected total gross final energy consumption by technology and sector in Mtoe and the total planned installed capacity (broken down into new capacity and major modernization) by technology and sector in MW

The calculated table of RES contribution to energy consumption in each sector is presented in Annex 3 of the draft NERP (see Table 2.2). According to estimates, the largest contribution of RES to energy consumption is expected for the heating and cooling sector - 11,478 ktoe in 2030, while for the electricity and transport sectors this figure is 3,804 ktoe and 961 ktoe, respectively.

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

The direction of using energy from renewable sources	2020 year	2021 year	2022 year	2023 year	2024 year	2025 year	2026 year	2027 year	2028 year	2029 year	2030 year
--	--------------	--------------	--------------	--------------	--------------	--------------	--------------	--------------	--------------	--------------	--------------

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
<i>without electricity consumed by electric transport</i>	1 332	1 782	1 867	2 135	2 339	2 522	2 700	2 870	3 106	3 266	3 484
Transportation	148	177	232	340	413	493	588	681	775	867	961
<i>excluding multipliers (coefficients)</i>	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 produced by wind and hydroelectric power plants.

(2) Electricity, hydrogen and gas from renewable energy sources are counted only once (as defined in Article 5(1) of Directive 2009/28/EC).

An estimate of the total contribution expected from each type of RES to achieve the 2030 indicative targets in the heating and cooling sector is presented in Annex 4 of the draft EE NAP (see Table 2.3). It is assumed 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 energy from heat pumps will be about 6% and solar energy - about 3%.

An assessment of the total contribution expected from each type of RES to achieve the indicative targets for 2030 in the electricity generation sector is presented in Annex 5 of the draft EE NAP (see Table 2.4). Thus, it is expected that in 2030 the installed capacity of RES facilities will reach 23.6 GW, and generation will reach 44.2 TWh·h. 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 solid biomass, biogas and biomethane plants will increase almost 9 times from 755 GWh in 2020 to 6,530 GWh in 2030. The wind energy sector is also expected to grow almost five times - from 3.3 TWh in 2020 to 15.8 TWh in 2030.

An estimate of the total contribution expected from each type of RES to achieve the indicative targets for 2030 in the transport sector is presented in Annex 6 of the draft EE NAP (see Table 2.5). Thus, it is expected that the use of electricity from RES in the transport sector will reach 320 ktoe in 2030; rail transport will account for 57%, and electric vehicles - 16%. The total consumption of liquid biofuels is expected to reach 325 ktoe in 2030, with the lion's share (73%) accounted for by bioethanol from food and feed crops (190 ktoe) and bioethanol from waste and residues (48 ktoe).

Table 2.3: Estimation of the total contribution (final energy consumption) expected for each renewable energy source to achieve the *mandatory* indicative targets for 2030 and the indicative intermediate trajectory for achieving the share of energy from renewable sources in heating and cooling systems for 2021-2030 (ktoe)

Heat production by type of source	2020 year	2021 year	2022 year	2023 year	2024 year	2025 year	2026 year	2027 year	2028 year	2029 year	2030 year
Geothermal (except for low-temperature geothermal heat for use in heat pumps)				6	13	19	25	31	38	44	50
Sunny	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
firm	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
aero	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
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. Estimation of the total consumption (installed capacity, gross electricity generation) expected from each renewable energy source in Ukraine to achieve the mandatory indicative targets for 2030 and the indicative intermediate trajectory for achieving the share of energy from renewable sources in electricity generation for 2021-2030

Electricity generation type of source	2020		2021		2022		2023		2024		2025		2026		2027		2028		2029		2030			
	MW	GW·h																						
Hydroelectric power plant	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		
with a capacity of more than 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		
with a capacity of 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		
Solar photovoltaic power plants, including	6 872	5 969	7 586	7 581	7 813	8 200	8 366	9 200	8 971	10 206	9 355	11 106	9 550	11 600	9 821	12 000	10 721	13 206	11 121	13 806	11 781	14 706		
manufacturers	6 093	5 236	6 381	6 430	6 443	6 830	6 545	7 330	6 681	7 750	6 833	8 200	6 984	8 520	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	2 567	3 080	2 642	3 170	3 289	3 980	3 434	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		
ground	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	4 720	13 150	4 920	13 795	5 120	14 740		
marine (offshore)																		100	350	200	701	300	1 051	
Biomass, including	210	755	274	941	349	1 200	499	2 100	651	2 680	794	3 280	934	3 860	1 074	4 540	1 209	5 200	1 344	5 870	1 448	6 530		
firm	107	284	150	388	192	500	209	800	345	1 310	479	1 820	609	2 310	717	2 740	831	3 200	951	3 680	1 030	4 120		
biogas	103	471	124	553	157	700	290	1 300	306	1 370	315	1 410	324	1 450	357	1 600	378	1 700	393	1 790	418	1 910		
biomethane at generating plants that use natural gas													50			100		200		300		400		500
Highly maneuverable power plants with quick start-up capability								300		500		700		850		950		1 050		1 150		1 250		
Energy storage facilities			1		100		200		300		380		440		490		540		590		640			
Total (from renewable sources)	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 transportation sector (ktoe)

The direction of using energy from renewable sources	2020 year	2021 year	2022 year	2023 year	2024 year	2025 year	2026 year	2027 year	2028 year	2029 year	2030 year
Electricity from renewable sources is consumed by transportation, 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
railroad transportation	35	50	63	73	95	119	131	144	156	169	181
other types of electric transport	8	13	20	26	32	43	52	61	70	79	88
Consumption of liquid biofuels (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 feed crops	51	85	100	115	124	137	148	158	169	179	190
bioethanol from waste and 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 feed crops			5	10	16	21	32	41	52	61	70
biodiesel from waste and residues, (II generation)					3	5	8	10	12	14	17
Biomethane consumption, including						1	2	3	4	5	6
biomethane from food and fodder crops						1	2	3	4	5	5
biomethane from waste and residues, (II generation)											1
Total energy consumption from renewable sources in the transportation sector	95	149	191	259	310	370	428	483	541	594	651
Total contribution of renewable energy to the achievement of the indicative renewable energy target 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 of bioenergy demand, broken down by heat, electricity and transport, as well as biomass supply by feedstock and origin (distinguishing between domestic production and imports). For forest biomass - estimation of its source and impact on LULUCF sector uptake

Annexes 4, 5, 6 to the draft NERP present the contribution of biomass to energy consumption in the heating and cooling, electricity generation, and transport sectors (see Tables 2.3, 2.4, 2.5), broken down by type of bioenergy (solid biomass, biogas, biomethane, bioethanol I and II generation, biodiesel I and II generation).

v. If applicable, other national trajectories and targets, including long-term and sectoral targets (e.g. share of renewable energy in the district heating sector, renewable energy use in the buildings sector, renewable energy production by cities, RES communities and self-generated renewable energy consumers, energy recovered from sludge from wastewater treatment)

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

For example, the National Economic Strategy for the period up to 2030¹⁰², approved by the Resolution of the Cabinet of Ministers of Ukraine No. 179 of March 03, 2021, states that the **share of renewable energy generation in total electricity production will reach 25% in 2030**.

The Concept for the Implementation of the State Policy in the Field of Heat Supply¹⁰³, approved by the Cabinet of Ministers of Ukraine on August 18, 2017, No. 569-r, sets targets for **achieving the share of alternative energy sources (renewable energy sources and secondary energy resources) in heat production by heat supply facilities in 2025 - 30%, in 2035 - 40%**.

The National Transport Strategy of Ukraine for the period up to 2030¹⁰⁴, which was 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 traditional fuels) and electricity (generated from both traditional and renewable sources) in the transport sector to 50% by 2030**.

2.2 Energy efficiency dimension

i. Elements defined in paragraph (b) of Article 4

- 1) Indicative national contribution in the field of energy efficiency to the achievement of the energy efficiency targets as set out in Article 1(1) and Article 3(5) of Directive 2012/27/EU, based on primary or final energy consumption, primary or final energy saved or energy intensity.**

The current national indicative energy efficiency targets are set by the Decision of the Council of Ministers of the Energy Community No. 2022/02/MC-EnC and the National Energy Efficiency Action Plan for the period up to 2030, approved by the Cabinet of Ministers of Ukraine No. 1803 of 29.12.2012. According to these documents, primary energy consumption in Ukraine in 2030 should not exceed 91,468 ktoe, and final energy consumption should not exceed 50,446 ktoe.

Taking into account the consequences of the full-scale invasion of Ukraine by the Russian Federation and its impact on the economy in general and the energy sector in particular, as well as changes in the demographic situation, the indicative values of primary and final energy consumption were revised as part

¹⁰² <https://www.kmu.gov.ua/npas/pro-zatverdzhenya-nacionalnoyi-eko-a179>

¹⁰³ <https://zakon.rada.gov.ua/laws/show/569-2017-%D1%80#Text>

¹⁰⁴ <https://zakon.rada.gov.ua/laws/show/430-2018-%D1%80#Text>

of the NECP preparation. The targets for primary energy consumption and final energy consumption were determined based on the results of TIMES modeling, which allows taking into account both technical and economic aspects of energy systems.

According to the modeling, primary energy consumption in Ukraine in 2030 should not exceed 72,224 ktoe, and final energy consumption should not exceed 42,168 ktoe.

Table 2.6: Indicative indicators of primary energy consumption and final energy consumption, thousand toe.

Assessment of energy consumption	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 ESU also envisages a reduction in the overall energy intensity of the economy from approximately 89 toe/million USD. (in 2020 prices) in 2023 to 76 toe/million USD in 2032. US dollars in 2032. It is expected that the target will be achieved as a result of the implementation of measures aimed at improving the efficiency of energy resources use in all sectors of the economy. The National Economic Strategy for the period up to 2030 also sets a sectoral target of reducing the energy intensity of the extractive industry by 30% by 2030.

2) The aggregate amount of end-use energy savings to be achieved between 2021 and 2030 in accordance with Article 7(1)(b) of the energy saving 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 for annual energy consumption reduction should be at least 0.8% of the total annual volume of 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 annual energy consumption reduction target.

Table 2.7. Calculation of the total amount of energy saved in end-use for 2021-2030, thousand toe.

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		2734.2
2030	303.8	303.8	303.8	303.8	303.8	303.8	303.8	303.8	303.8	3038
Total amount of energy saved in end use										16 405.2

Source: Authors' calculations based on the State Statistics Service data

- 3) Indicative milestones for a long-term strategy for the renovation of the national stock of residential and non-residential buildings in public and private ownership, a roadmap with internally defined measurable progress indicators, an empirically based assessment of the expected amount of energy savings and other benefits, and contributions to the achievement of the Union's energy efficiency targets in accordance with Directive 2012/27/EU and Article 2(a) of Directive 2010/31/EU.

The Ministry of Infrastructure developed and approved the Long-Term Strategy for Thermal Modernization of Buildings for the period up to 2050 by the CMU Decree No. 1228-p of December 29, 2023¹⁰⁵. The main goal of the Strategy is to decarbonize the national building stock by 2050. The Strategy defines the following intermediate goals for 2030:

- achievement of the target energy savings in government buildings at the level of an annual reduction in energy consumption of 1% of the area of the respective buildings;
- implementation and operation of energy management systems in at least 90% of communities;
- final energy consumption in the buildings sector was reduced by 15%;
- the share of residential and public buildings that meet the minimum requirements for energy efficiency of buildings is at least 36%;
- the share of public buildings with close to zero energy consumption is at least 10%;
- The amount of investments in energy efficiency in buildings is at least EUR 87 million;
- the number of qualified personnel in the field of energy efficiency at the level of at least 100 thousand people per year.

¹⁰⁵ <https://zakon.rada.gov.ua/laws/show/1228-2023-%D1%80#Text>

Table 2.8. Some expected results of the first stage of the Strategy for Thermal Modernization of Buildings until 2050

Name	Units of measurement	Residential buildings		Non-residential buildings	
		individual	BKB	public	other non-residential
Buildings thermally modernized (fully or partially)	units.	3 088 352	97 916	15 784	74 192
Renovated building areas	million m ²	220,6	260,0	59,4	66,8
Annual natural gas (natural gas equivalent) savings*.	billion cubic meters	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 savings of natural gas according to its share in heat generation (30%) (and the estimated amount of energy savings in natural gas equivalent)

The expected level of thermal modernization of buildings is based on an ambitious scenario. Given the negative consequences of a full-scale invasion of Ukraine by the Russian Federation, including the difficulty of attracting private investment and debt capital, the baseline scenario of thermal modernization described in the Strategy was taken into account for the purposes of the NECP to be used in the WAM scenario. According to the baseline scenario, 10% of buildings are expected to be thermally modernized. The Concept for Implementation of the State Policy in the Field of Energy Efficiency of Buildings in terms of Increasing the Number of Buildings with Close to Zero Energy Consumption (hereinafter referred to as the NZEB Concept) also sets targets for improving energy efficiency in the buildings sector. Thus, the NZEB Concept envisages achieving a 24% reduction in final energy consumption in the residential sector and a 16% reduction in final energy consumption in public buildings by 2025.

4) The total usable area to be renovated or the equivalent annual energy savings 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 implementing Article 5 of Directive 2012/27/EU. The energy saving target in public authority buildings is expressed as a numerical value of the annual reduction in

energy consumption achieved as a result of bringing buildings with an area of at least 1% of the area of buildings that meet all such criteria to the minimum energy efficiency requirements:

- 1) are in state or municipal ownership;
- 2) where the office of the central executive body is located;
- 3) the heated area exceeds 250 square meters.

According to preliminary estimates by the Ministry of Infrastructure, the number of buildings that meet the above criteria is about 100. The average heated area of a public building in Ukraine is 9447.5 cubic meters, and the average value of the specific energy consumption for public buildings is 51.69 kWh/cubic meter. The average value of the minimum requirements for public buildings is 25 kWh/cubic meter. Thus, bringing such buildings into compliance with the minimum requirements can reduce energy consumption by 51%. **The expected energy savings in buildings that meet the above criteria are 21.4 toe/year and 192.4 toe by 2029.**

At the same time, it should be noted that in order to determine and monitor the achievement of the energy saving target in public authority buildings in accordance with the Law of Ukraine "On Energy Efficiency of Buildings", it is necessary to create a database of public authority buildings, which is part of the overall national Building Database. As of December 2023, the Building Database has not been formed. With the support of the Energy Efficiency Reform in Ukraine Project GIZ, a pilot phase of the Database implementation was conducted. As part of the pilot phase, regional state administrations in 12 regions of Ukraine were involved and energy and performance data of 6164 budget buildings were collected.

ii. Indicative milestones for 2030, 2040 and 2050, internally established measurable progress indicators, empirically based estimates of the expected amount of energy savings and other benefits, and their contribution to the achievement of the Union's energy efficiency objectives as set out in the roadmaps set out in the long-term renovation strategies for the national stock of public and private residential and commercial buildings in accordance with Article 2(a) of Directive 2010/31/EU

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

iii. If applicable, other national targets, including long-term targets or strategies and sectoral targets, as well as national targets in areas such as energy efficiency in the transport sector and in heating and cooling

Heat supply

The current targets for the heat supply sector are set out in the Concept for the Implementation of the State Policy in the Heat Supply Sector, approved by the Cabinet of Ministers of Ukraine by Resolution No. 569 of 18.08.2017, with the implementation period of 2017-2035:

- ensuring 100 percent commercial metering of consumed heat energy;
- specific consumption of conventional fuel in the production of heat by boiler houses - 155 kg of fuel equivalent/Gcal at the first stage of implementation;
- the share of losses in heating networks is 12% at the first and 10% at the third stage of implementation.

As of 2024, it can be stated that only a part of the measures envisaged by the Concept has been implemented and key targets have not been achieved. It is necessary to monitor the current state of development of the heat supply sector, determine the directions of development of the sector and update the targets, and adopt an updated program document to replace the current Concept (PM_EE_WAM_08 Update of the Concept for the Implementation of State Policy in the Heat Supply Sector) based on such analytical work.

2.3 Energy security dimension

i. Elements defined in paragraph (c) of Article 4

The key documents that define the goals of **deepening the diversification of sources and routes of energy supplies** from third countries with the potential to reduce dependence on energy imports are the National Economic Strategy for the period up to 2030¹⁰⁶ (NES) and the Energy Strategy of Ukraine for the period up to 2050¹⁰⁷ (ESU).

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

The NES's goals include ensuring the formation of a volume of maneuverable capacities sufficient to ensure the cost-effective operation of all generators.

The Energy Security Strategy envisages two relevant strategic goals:

- Objective 2. Sustainability of the energy sector;
- Objective 4. Energy efficiency in the use of energy resources and energy efficiency of the national economy.

One of the tasks of the IPS includes the introduction of highly maneuverable capacities to ensure the balance reliability of the IPS of Ukraine and support further integration of RES:

- maneuvering capacities of HPPs and PSPPs;
- balancing and backup capacities of TPPs using combined fuel (natural gas and/or biomethane), and other technologies; gas turbine and gas piston plants are also mentioned;
- capacities of energy storage facilities, including Power-to-X long-term (seasonal) storage.

The targets for 2032 in terms of total available capacity are 9.4 GW of semi-peak and peak generation (without technology details), as well as 4.9 GW of HPPs and 4.1 GW of PSPs. The increase in the available capacities of HPPs will be 30%, and PSPPs - about 2.4 times. At the same time, the ESU contains a reference to the Hydropower Development Program of Ukraine until 2026¹⁰⁸, which contains a goal to increase the share of maneuvering capacities of HPPs and PSPPs in the total balance by 2026 to 15.5%.

As for the UZE, their active use is expected after 2032. By 2050, the capacity of EPS will triple compared to the forecasted 2024 and amount to 1.56 GW. As for the demand side management program, which should become a separate area of energy efficiency, the ESU envisages only the implementation of pilot projects until 2032.

Detailed targets are presented by the TSO in the Report on the Assessment of the Compliance (Sufficiency) of Generating Capacities to Cover the Forecasted Electricity Demand and Ensure the Required Reserve in 2023. See also Section 2.4.3. Market integration (Dimension "Internal energy market").

In the issue of **eliminating restrictions or interruptions in energy supply** in order to increase the resilience of regional and national energy systems, the main goals are set by the ESU, the Cybersecurity Strategy of Ukraine¹⁰⁹ (approved by the Decree of the President of Ukraine of August 26, 2021 No. 447/2021), the Laws of Ukraine "On Critical Infrastructure"¹¹⁰, "On the Basic Principles of Ensuring

¹⁰⁶ <https://zakon.rada.gov.ua/laws/show/179-2021-%D0%BF>

¹⁰⁷ <https://zakon.rada.gov.ua/laws/show/373-2023-%D1%80#Text>

¹⁰⁸ https://ips.ligazakon.net/document/view/kr160552?an=1&ed=2016_07_13

¹⁰⁹ <https://zakon.rada.gov.ua/laws/show/447/2021#Text>

¹¹⁰ <https://zakon.rada.gov.ua/laws/show/1882-20>

"Cybersecurity of Ukraine"¹¹¹, "On the Electricity Market"¹¹², "On the Natural Gas Market"¹¹³, and bylaws for their implementation.

For Ukraine, it is particularly important to ensure a constant supply of energy without restrictions or interruptions. That is why considerable attention is paid to the protection of energy facilities.

The ESU sets out to ensure comprehensive security of energy sector infrastructure facilities. The target indicator is to ensure physical, engineering and cyber protection of 100% of the facilities. It is separately stipulated that in the context of a full-scale invasion of Ukraine by the Russian Federation, the protection of critical infrastructure facilities is a priority, and the system for managing such protection is defined at the level of the Law of Ukraine "On Critical Infrastructure." The Concept of Ensuring the National Resilience System, approved by the Decree of the President of Ukraine of September 27, 2021, No. 479/2021¹¹⁴, also indicates that such a system should provide for the safety and security of critical infrastructure facilities, including sustainable energy supply and heat supply, as a basic element.

Another group of targets is the formation and preservation of energy reserves - natural gas, coal, fuel oil - as part of the Government's activities to prepare for the autumn and winter periods¹¹⁵. As a rule, targets are set at the Government level in the form of orders¹¹⁶ or in departmental decisions (schedules) based on the results of coordination of these indicators with market participants. Some of the targets are regulated by law. At the end of 2022, amendments to the Law of Ukraine "On the Natural Gas Market" defined the obligation of the Ministry of Energy to calculate the target level of gas storage facilities and to formulate a schedule for filling gas storage facilities. In 2023, the Law of Ukraine "On Minimum Oil and Oil Products Reserves" was adopted¹¹⁷, which provides for the creation of reserves for 90 days of net imports or 61 days of domestic consumption.

Finally, the framework laws on gas and electricity markets define the government's responsibility for minimum security of supply standards and their monitoring. The Ministry of Energy is obliged to approve rules on security of supply of natural gas and electricity, as well as the National Action Plan (regulating preparation for and response to a crisis situation in natural gas supply), which are binding on all market participants, and to monitor security of supply (for electricity, jointly with the Regulator, the transmission system operator and other relevant institutions).

All of these elements have found their place in the comprehensive Energy Security Strategy¹¹⁸ (approved by the Cabinet of Ministers of Ukraine on August 4, 2021, No. 907-p), which is a strategic planning document that contains an analysis of threats, identifies priorities, describes strategic choices, goals and objectives aimed at preventing threats to Ukraine's energy security. The Strategy's tasks are organized around eight strategic goals:

- 1) Availability of energy sources and energy resources of all types for consumers;
- 2) Sustainability of the energy sector;
- 3) Economic efficiency of the energy sector, energy supply systems and import substitution of mineral raw materials;
- 4) Energy efficiency in the use of energy resources and energy efficiency of the national economy;

¹¹¹ <https://zakon.rada.gov.ua/laws/show/2163-19>

¹¹² <https://zakon.rada.gov.ua/laws/show/2019-19#Text>

¹¹³ <https://zakon.rada.gov.ua/laws/show/329-19#Text>

¹¹⁴ <https://www.president.gov.ua/documents/4792021-40181>

¹¹⁵ <https://zakon.rada.gov.ua/laws/show/515-2023-%D0%BF#Text>

¹¹⁶ See, e.g., <https://zakon.rada.gov.ua/laws/show/586-2021-%D1%80#Text>.

¹¹⁷ <https://zakon.rada.gov.ua/laws/show/3484-IX#Text>

¹¹⁸ <https://zakon.rada.gov.ua/laws/show/907-2021-%D1%80#Text>

- 5) Environmentally acceptable impact of energy on the environment;
- 6) Integration of the energy sector into the EU's political, technological, technical, economic and legal space;
- 7) Independence of the state in the formation and implementation of domestic and foreign energy policy, ensuring the realization of national interests;
- 8) Development of Ukraine's scientific, technical, innovative and educational potential for the needs of the energy sector.

In the context of gaining EU membership, it is important for Ukraine to integrate into the processes of ensuring security of supply, which is manifested in participation in regional and pan-European risk assessment, planning preventive steps and actually responding to crisis situations in the supply of both natural gas (according to Regulation (EU) 2017/1938) and electricity (according to Regulation (EU) 2019/941).

ii. National goals to deepen the diversification of sources and routes of energy supplies from third countries in order to increase the resilience of regional and national energy systems

The National Security Strategy¹¹⁹ (approved by Presidential Decree No. 392/2020 of September 14, 2020) declares the need to diversify sources and routes of energy supply among its goals. The NES defines the overall goal of ensuring diversification of energy supplies at the level of no more than 30% from one supplier. At the same time, the target is formally defined for nuclear fuel (see below), since imports of gas, oil products and coal, as well as electricity, are quite diversified in terms of suppliers and countries of origin - and this trend has intensified after the ban on imports of any goods from the Russian Federation¹²⁰ and the actual termination of trade with the Republic of Belarus.

iii. If applicable, national targets for reducing dependence on energy imports from third countries in order to increase the resilience of regional and national energy systems

The Energy Security Strategy includes energy security among its priorities:

- to achieve Strategic Goal 3 "Economic efficiency of the energy sector, energy supply systems and import substitution of mineral raw materials"
 - Stimulating import substitution, in particular through the development of bioenergy, wind energy, and a reasonable increase in energy production
- to achieve Strategic Goal 7 "Independence of the state in the formation and implementation of domestic and foreign energy policy, ensuring the realization of national interests":
 - Preventing Ukraine's growing dependence on external suppliers, ensuring an appropriate level of diversification of energy resources and technologies, in particular through economically justified growth of the share of renewable energy sources and local energy sources in the energy balance of Ukraine; economically justified growth of natural gas and oil production and other types of energy resources;
 - Bringing coal production volumes in line with Ukraine's energy needs on the basis of market principles of management and competition, with a defined term of coal use for energy needs.

¹¹⁹ <https://zakon.rada.gov.ua/laws/show/392/2020#Text>

¹²⁰ <https://zakon.rada.gov.ua/laws/show/426-2022-%D0%BF#Text>

The NES includes indicators for the strategic goal "Ensuring a high level of energy security and integration of Ukraine into the European energy market":

- forming and ensuring the safety of crude oil and petroleum products reserves in the amount of at least 90 days of average daily consumption in Ukraine;
- reducing the level of import dependence (gross energy imports in total primary energy supply) to 33%;
- reducing the share of one supplier in the nuclear fuel market to 60%.

In particular, the document states high import dependence on nuclear fuel (due to the depletion of existing uranium deposits and high production costs, domestic production covers only a third of the needs) and gas, high depletion of hydrocarbon production wells, more than 70% import dependence on oil products, and low diversification, which together create a high risk of possible interruptions in energy supplies for the economy.

Separately, in terms of the development of the extractive industry, the NES envisages, under strategic goal 3 "Ensuring the satisfaction of the needs of the national economy, creating a reliable basis for the production of high value-added products", an indicator in the form of meeting 100% of the population's needs for natural gas through domestic production. At the same time, the prospect of gradual lifting of regulation in the gas market after the end of martial law does not allow allocating Ukrainian production resources for the needs of a specific category of consumers, such as the population (households). Target setting to reduce import dependence requires taking into account the entire demand in the economy (i.e., all categories of consumers).

The goals of the ESU include 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 industry, which includes:

- Electricity production and export;
- 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 power generation;
- Implementation of the nuclear cycle from nuclear fuel production to radioactive waste management.

iv. National goals to increase the flexibility of the national energy system, in particular through the deployment of domestic energy sources, demand management and energy storage

See above and section 2.4.3. Market integration (Dimension "Internal Energy Market").

2.4. Dimension "Domestic energy market"

2.4.1 Integration of energy systems

i. The level of energy system integration that the Member State aims to achieve in 2030, taking into account the 2030 energy system integration target of at least 15%, together with a strategy starting from the 2021 level, determined in close cooperation with the affected Member States, taking into account the 2020 energy system integration target of 10% and the urgency indicators below:

(1) Price differences on the wholesale market exceeding the indicative threshold of 2 EUR/MWh between Member States, regions or trading areas;

(2) The rated capacity of the interconnectors is below 30% of the peak load;

(3) The nominal capacity of interconnectors is below 30% of the installed capacity of RES generation.

Each new interconnector is subject to a socio-economic and environmental cost-benefit analysis and is implemented only if the potential benefits exceed the costs

The ESU sets a target to expand the total capacity of the IPS of Ukraine's interconnections with the power systems of ENTSO-E countries to 6 GW by 2032. At the same time, the potential 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 10%.

The analysis of price dynamics on the day-ahead markets (DAM) of Ukraine and the EU countries (Poland, Romania, Slovakia and Hungary) shows that in 2020-2023¹²¹ the difference between the daily price indices of the DAM Base in the vast majority of periods (days) is higher than 2 EUR/MWh (relative to Poland - in 98% of periods, Romania - 95.6%, Slovakia - 94.9%, Hungary - 95.8%). The average difference between the daily indices of the Ukrainian DAM Base and the markets of Poland amounted to 98.0 EUR/MWh, Romania - 269.8 EUR/MWh, Slovakia - 268.7 EUR/MWh, Hungary - 285.4 EUR/MWh.¹²²

The high price divergence between the electricity markets of Ukraine and the EU is not only due to the insufficient capacity of interconnectors. To a large extent, it is also caused by the lack of integration of spot electricity markets and the regulation of prices on the Ukrainian DAM by the Regulator (application of upper and lower price caps).¹²³

After the start of the full-scale invasion of Ukraine by the Russian Federation on February 24, 2022, electricity consumption in the IPS of Ukraine decreased significantly by about 30-35%. The peak loads in the power system have changed accordingly. It is estimated that in 2023, the ratio of the net transmission capacity (NTC) of Ukraine's interconnectors to the peak load in the Ukrainian power system (17445 MW)¹²⁴ was about 10% for electricity imports and 3% for exports to the EU (taking into account the restrictions imposed by ENTSO-E).¹²⁵

As a result of the full-scale invasion of Ukraine by the Russian Federation, intense hostilities, especially in the areas with the highest concentration of RES generation facilities in the southern and eastern regions, and systematic shelling of Ukraine's energy infrastructure, the installed generating capacity of RES facilities operating in the IPS of Ukraine has changed due to their damage, destruction and/or occupation. It is estimated that in 2023, the ratio of the net transmission capacity (NTC) of Ukraine's interstate cross-border crossings to the installed capacity of RES generation (including large hydropower generation) was about 13% (for electricity imports) and 4% (for exports to the EU).

All the above indicators indicate the need to increase Ukraine's interconnectors' capacity to ensure better electricity market integration.

¹²¹ The period during 2023 considered in the analysis of electricity prices on the DAM includes January-September 2023.

¹²² <https://map.ua-energy.org/uk/resources/5bee4464-ba9f-4117-a4ca-f71584bd5f54/>

¹²³ <https://map.ua-energy.org/uk/resources/cc738a86-c28e-4a3a-86b6-bd965fd27663/>

¹²⁴ According to the Report on the assessment of compliance (sufficiency) of generating capacities to cover the projected demand for electricity and ensure the necessary reserve in 2023.

¹²⁵ <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/>

2.4.2 Energy transmission infrastructure

i. Key infrastructure projects in electricity transmission and gas transportation, as well as modernization projects, where appropriate, that are necessary to achieve the goals and targets of the five dimensions of the Energy Union Strategy

Electricity infrastructure

Ukraine is not yet involved in EU projects of common interest (PCI) related to the development of electricity transmission infrastructure. The list and description of Ukraine's key transmission system development projects in terms of building interstate power grids is contained in the Transmission System Development Plan for 2023-2032, developed by the TSO and approved by the Regulator (NEURC).¹²⁶

To strengthen cross-border electricity connections, Ukraine is implementing the following key projects of mutual interest (PMI):

- restoration of the 400 kV Mukachevo (Ukraine) - Velke Kapušany (Slovakia) overhead power line, aimed at increasing the capacity of the interstate crossing to 1,000 MW. The expected capital investment is EUR 10.5 million.¹²⁷ The project is scheduled to be completed in 2028;
- restoration and modernization of the 750 kV overhead power line South Ukrainian NPP (Ukraine) - Issacca (Romania), aimed at increasing the capacity of the interstate crossing to 1,000-1,200 MW. The expected capital investment is EUR 383.3 million.¹²⁸ The project is scheduled to be completed in 2026;
- construction of the 750/400/330 kV Lvivska substation (SS), which is envisaged to strengthen electrical connections with ENTSO-E. This project is intended to build a 400 kV overhead line (OHL) Lviv - Rzeszów 2 in 2027 and a 400 kV OHL Lviv - Chelm in 2029. Also, in the future, after 2025, the possibility of constructing a 400 kV overhead line Lviv-Krosno is being considered.¹²⁹ All of these new lines are at the pre-project stages, so based on the data on the capacity of transmission lines of similar voltage classes, it is assumed that their capacity will be about 250 MW.

Natural gas transportation and storage infrastructure

Given that the transit of natural gas from the Russian Federation through Ukraine to the EU is likely to stop in 2025, demand for natural gas in the country will remain, and the potential for natural gas exports to the EU may be created, the following goals are set for the natural gas transportation and storage infrastructure in 2025-2030 in public policy documents:

- Ensuring sufficient interconnection for natural gas transportation between Ukraine and the EU/Energy Community;
- modernization (reconstruction) of gas infrastructure facilities to maintain proper technical conditions, increase energy efficiency and reduce emissions of harmful substances, as well as optimize the operation of such facilities;
- perspective re-profiling of certain gas infrastructure facilities for new types of activities as part of decarbonization.

¹²⁶ <https://zakon.rada.gov.ua/rada/show/v0266874-23#Text>

¹²⁷ <https://www.energy-community.org/regionalinitiatives/infrastructure/PLIMA/EL07.html>

¹²⁸ <https://www.energy-community.org/regionalinitiatives/infrastructure/PLIMA/EL09.html>

¹²⁹ According to the Report on the assessment of the adequacy (sufficiency) of generating capacities to cover the projected electricity demand and ensure the necessary reserve in 2023, all these new lines are at the pre-project stages.

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

As of April 2024, the following capacity is available on international connections to the EU and the Energy Community:

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

Nº	Name of the point (VIP - virtual interconnection point; IP - interconnection connection)	Country	Input to Ukraine, mln m3/day	Output from Ukraine, mln m3/day	Notes.
1	VIP Ukraine-Poland	Poland	6,4	12,9	Capacity to enter 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	27	19	
4	VIP Bereg	Hungary	8	48,8	The entry capacity is currently available until 30/09/2024.
5	IP Isaccea 1/Orlivka 1	Romania	0	19,1	The entry capacity is currently interruptible in the amount of up to 11.5 mcm/day Exit capacity is available in case of booking capacity at the Kaushany entry point.
6	IP Ananyiv	Moldova	0	0	
7	IP Grebenyky	Moldova	0	36	The entry capacity is currently intermittent up to 7 mcm/day, depending on the season.

8	IP Kaushany	Moldova	36	12	The capacity is available in case of capacity reservation at the entry and/or exit point Isaccea 1/Orlivka 1 and/or virtual exit point to the border consumers of the Republic of Moldova
9	IP Oleksiyivka	Moldova	0	7,9	
10	A virtual point to the border consumers of the Republic of Moldova	Moldova	-	0,85	The capacity is available in case of booking capacity at the Kaushany entry point and/or Isaccea 1/Orlivka 1 entry point

Source: GTS Operator of Ukraine LLC

The goals for the development of existing connections are stipulated by both Ukraine's international obligations and certain strategic documents. Thus, in accordance with Article 5, Annex III of Regulation (EU) 2017/1938, as adapted in the Energy Community, all cross-border gas pipelines must ensure a constant (guaranteed) bilateral gas flow between the Contracting Parties to the Energy Community (i.e. Ukraine and Moldova). At the same time, for the existing gas pipelines, by February 1, 2024, the TSOs must submit an application to the relevant state authorities to ensure bilateral flow or to be exempted from this obligation. GTS Operator of Ukraine LLC is currently unable to obtain the relevant exemption or submit an application, given that the provisions of Regulation (EU) 2017/1938 have not yet been implemented in Ukrainian legislation, and therefore the Ministry of Energy and the NEURC are not yet vested with the relevant powers to make such decisions. At the same time, according to preliminary estimates of the GTS Operator, the demand for capacity in the direction from Moldova to Ukraine was identified for the Oleksiyivka and Grebenyky IPs during the assessment of market demand for new (increased) capacity (see below). As for the Ananiyiv IP and the virtual point of entry to the border consumers of the Republic of Moldova, there is no need to create firm capacity in both directions.

In addition, some strategic documents define similar goals in this area: for example, the ESU - to increase guaranteed capacities for natural gas transportation with strategic partners of the EU, and the NES - to create a hub on the basis of Ukrainian gas storage facilities with increased capacity. These goals should be interpreted in the light of the relevant market demand.

Thus, the goal of ensuring sufficient connectivity for gas transportation between the EU/Energy Community/Ukraine should be realized in two ways:

- ensuring firm capacities on IPs with the EU/European Energy Community, which includes, first of all, legal confirmation of physically available capacities for long-term reservation of transportation services by customers;
- development of new capacities based on the market demand analysis.

As of April 2024, the capacities entering Ukraine from Poland, Hungary and Romania¹³⁰ are available for booking by customers of transportation services only for limited time periods without the possibility of

¹³⁰ In the case of Slovakia, the problem concerns additional physically available capacity.

booking for longer periods (more than 1 year) even if the relevant physical infrastructure is available. The legal confirmation of physically available capacities as firm is important both for the development of energy markets and for security reasons. This issue deserves special attention from the European Commission.

In addition, in accordance with the GTS Code, the TSO continuously assesses the market demand for increased capacity for interconnection points. The assessment of the potential demand for new (increased) capacity was carried out in July 2023. During this period, customers of transportation services had the right to submit non-binding applications. Based on the non-binding applications received from natural gas market participants, the demand for capacity to enter Ukraine was identified in two directions: Poland and the Trans-Balkan direction. According to the generalized non-binding bids, the maximum demand for guaranteed capacity from Poland to Ukraine amounted to 9 million m³/day,¹³¹ from Romania to Ukraine - 18 million m³/day¹³², from Moldova to Ukraine - 20 million m³/day¹³³.

In accordance with the EU Capacity Allocation Network Code (CAM NC), as well as in pursuance of the GTS Code, the GTS Operator of Ukraine LLC in cooperation with GAZ-SYSTEM held public consultations on capacity increase at the state border between Poland and Ukraine (consultations lasted until the end of November 2023). The draft proposal for the project of new (increased) capacity between the Polish and Ukrainian GTSs¹³⁴ was prepared by the TSOs on the basis of non-binding demand bids received from market participants during the market demand assessment procedure conducted between 03.07-28.08.2023. In accordance with the GTS Code, the next stage of the procedure for new (increased) capacity on interconnectors is the approval and publication of information on the procedure for new (increased) capacity (Chapter 3 of Section XX).

In addition, in pursuance of the Memorandum of Cooperation on the creation of the Vertical Corridor, signed on January 19, 2024, GTSOU, together with the TSOs from Romania and Moldova, on February 1, 2024, launched public consultations on the draft project proposal for the project of new (increased) capacity on the route Isaccea/Orlovka I - Kaushany - Grebenyky:¹³⁵

¹³¹ https://tsoua.com/wp-content/uploads/2023/10/2023_10_23_MDAR_PL-UA_GAZ-SYSTEM_GTSOU_UKR.pdf

¹³² https://tsoua.com/wp-content/uploads/2023/10/2023_10_23_MDAR_UA-RO_UKR.pdf

¹³³ https://tsoua.com/wp-content/uploads/2023/10/2023_10_23_MDAR_UA-MD_UKR.pdf

¹³⁴ https://tsoua.com/wp-content/uploads/2023/10/20231030_Consultation_document_INC-PL_UA_UKR.pdf

¹³⁵ <https://tsoua.com/news/ogtsu-rozpochynaye-publichni-konsultacziyi-po-rozshyrennyu-reversnoyi-potuzhnosti-transbalkanskogo-truboprovodu-v-ramkah-procedury-novoyi-zbilshenoyi-potuzhnosti-spilno-z-operatoramy-gts-rumuniyi-t/>



This route already provides for the possibility of transporting gas to Ukraine even in the absence of gas transit from Russia and increasing this possibility through minor investments on the part of Ukraine and Moldova (could be made by 2028) and regulatory measures to encourage the use of this route through tariffs for entry/exit points on the part of Moldova and Romania.

- 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.*

The ESU defines the strategic goal of updating and modernizing the energy infrastructure in accordance with the best international standards, which includes optimizing the idle gas infrastructure and further efficient operation of its facilities that will remain in operation. In this regard, it is envisaged, in particular:

- Increasing the level of automation of monitoring and control of gas distribution stations (GDS);
- Reducing the amount of process gas losses;
- optimization of the number of GDSs, taking into account the reduction in consumption;
- replacement of GDSs with new automatic block-modular ones;

Reconstruction of GDS and priority compressor stations.

In addition, the NES envisages optimization of capacities and technological parameters of the GTS operation in accordance with expected load scenarios, as well as the development and implementation of economically feasible projects to optimize and modernize the GDS in accordance with the needs of the economy, reconstruct the necessary outdated networks and prepare the GDS for hydrogen transportation.

The National Energy Efficiency Action Plan envisages the implementation of energy efficiency measures in the grids. In addition, the Action Plan for the Implementation of Ukraine's Climate Policy as part of participation in the Global Methane Pledge, a global initiative to reduce methane emissions, provides for a comprehensive task to reduce methane leakage and emissions during the production, processing and transportation of natural gas and oil with credit funds or funds from international partners.

- 3) *Prospective re-profiling of existing gas infrastructure facilities for new activities as part of decarbonization.*

The ESU envisages the introduction and implementation of projects aimed at carbon capture and storage (CCUS), which will help to offset the existing residual emissions in 2050. In addition, the ESU is considering alternative uses of the existing infrastructure for the transportation of biomethane, synthetic methane and hydrogen.

In terms of preparations for hydrogen transportation, from an infrastructure point of view, Ukraine is supposed to create a dedicated corridor for its transportation through repurposed or new networks by 2030. At the same time, there are no plans to mix methane gas with hydrogen in existing gas networks.

At the beginning of 2022, draft technical requirements were prepared and a generalized study of the possibility of using the Ukrainian GTS for hydrogen transportation with an estimated budget of EUR 3 million was previously agreed with the European Commission Delegation to Ukraine. In addition, the specialized scientific institution, the Karpenko Institute of Physics and Mechanics of the National Academy of Sciences of Ukraine (Lviv), is implementing a project of fundamental research on the mechanisms of interaction of hydrogen with pipe steels, their flooding, corrosion and fracture at the micro and macro levels, taking into account the condition of existing gas pipelines and operational factors (load, environment). The project was launched in May 2023 and is scheduled to be completed in June 2024. GTS Operator of Ukraine LLC joined the project by providing fragments of pipes for research - those that have been in operation (34 years) and analogues from emergency stocks.

In addition, in November 2021, a memorandum of understanding was signed between GTSOU, JSC Ukrtransgaz, NJSC Naftogaz of Ukraine, Eco-Optima LLC RAG Austria AG, Open Grid Europe GmbH, Gas Connect Austria GmbH, Bayerngas GmbH, Eustream a.s., Nafta a.s., Bayernets GmbH on the launch of the H2EU+Store project, which envisages the development of hydrogen production and underground storage in Ukraine, and the formation of a pipeline corridor from Ukraine through Slovakia and Austria to Germany.

Oil transportation and storage infrastructure

The ESU envisages a number of oil infrastructure projects. Ukrtransnafta is responsible for their implementation. The company's plans include both the modernization of the oil transportation system and its development, including to ensure the energy security of Ukraine and neighboring countries by diversifying the routes of oil and oil products delivery by pipelines.

In the context of modernization, Ukrtransnafta's plans include:

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

Two promising projects are aimed at diversifying oil supply sources and routes to attract additional transportation volumes:

1) The Brody - Adamova Zastava:

Until recently, Ukraine could use two oil supply routes - the Druzhba pipeline, which transported oil from Russia, and the Pivdennyi offshore oil terminal, which received oil from the Black Sea. The situation was similar in Poland, which until recently imported oil through the Druzhba pipeline system and through the Gdansk oil port on the Baltic Sea.

With the start of the full-scale invasion, the Russian oil supply route ceased to exist. In June 2022, the EU Council adopted the sixth package of sanctions, which prohibits, among other things, the purchase, import or maritime transportation of oil and certain oil products from Russia to the EU. A temporary exemption

from the sanctions applies only to oil imported by pipeline to EU countries that, due to their geographical location, are particularly dependent on supplies from Russia and have no other viable options for securing them due to the insufficient development of oil transportation infrastructure. Hungary, the Czech Republic, Slovakia, and Bulgaria enjoy this privilege.

The significant restriction of Russian oil supplies, as well as the constant risk of interruption of these supplies, opens up ample opportunities for attracting oil from the Caspian region, provided that the appropriate infrastructure is built.

The Brody-Adamova Zastava project will connect the oil transportation systems of Ukraine and Poland, while the latter is connected to the German oil transportation system. The project envisages the possibility of transporting oil in both directions - from the Polish port of Gdansk to Ukraine and from the Black Sea ports of Ukraine to Poland and Germany - through the construction of a 700 mm diameter and 396.3 km long pipeline (125.7 km in Ukraine and 270.6 km in Poland). The project will allow to transport up to 10 million tons of oil per year from the Baltic Sea to Ukraine (or vice versa) with the possibility of increasing the volume to 20 million tons per year. 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 Energy Community interest (PECI).

Map of the Brody - Adam's Bastion project



Source: "Sarmatia."

To implement the project, a joint venture MPR "Sarmatia" sp. Z o.o.¹³⁶ was established, whose members are JSC Ukrtransnafta (28.78%), Polish operator PERN (28.78%), Azerbaijani company SOCAR (25.32%), Georgian company GOGC (16.10%), and Lithuanian company AB Klaipedos Nafta (1%). Preparatory work, including market research and a feasibility study, has been virtually completed. The project is currently looking for a strategic investor, with an estimated cost of EUR 14 million (design) and approximately EUR 400 million (construction). Subject to the availability of funding, as well as support at the state level in Ukraine and Poland (in particular, the extension of the Law of the Republic of Poland on the Preparation and Implementation of Strategic Investments in the Oil Sector of February 22, 2019), the project can be implemented in 2-3 years.

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

Currently, the southern branch of the Druzhba pipeline transports only one type of oil in transit from the Republic of Belarus. However, if measures are taken to transport other types of oil, it is possible to use the existing infrastructure to transport oil from Ukrainian ports to Slovakia, Hungary, and the Czech Republic.

No additional investments are required to implement the project. JSC Ukrtransnafta already had experience in transporting different grades of oil from the port of Odessa to the Kremenchuk refinery. At the same time, the project requires support from the recipient countries at both the governmental and corporate levels. In addition, it is worth noting that the project depends on the possibility of using Ukrainian Black Sea ports to supply oil from other countries.

Hydrogen transportation and storage infrastructure

The 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 with a guaranteed price in euros and long-term contracts. The ESU defines the task of building an export-oriented energy industry, which includes the production and export of hydrogen and alternative gases. According to the draft Hydrogen Strategy of Ukraine until 2050, renewable hydrogen production is expected to start in 2030,

¹³⁶ <https://sarmatia.com.pl/about-us/?lang=en>

simultaneously with the commissioning of the Central European Hydrogen Corridor, and export volumes of 0.3-0.4 million tons per year in 2035 and 1.5-2 million tons by 2050.

At the same time, it is worth considering the criteria for green hydrogen in force in the EU¹³⁷. Thus, according to these rules,¹³⁸ hydrogen is considered green when produced from electricity:

- 1) generated by dedicated capacities that are not connected to the grid or, in case of connection, with confirmation that electricity has not been taken from the grid (Article 3);
- 2) selected from the network using one of four options:

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

Option B: if the emission intensity of the electricity system within the trade 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 concrete evidence that the electricity used for hydrogen production has reduced the need to redispatch renewable generation facilities;

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

At the same time, the optimal method of hydrogen transportation is the subject of ongoing political and scientific debate. There are three transportation methods that are related to oil and gas infrastructure and may be relevant for Ukraine:

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

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

The Central European Hydrogen Corridor (CEHC) project,¹³⁹, is a joint project of the GTS operators of Ukraine (GTS Operator of Ukraine LLC), Slovakia (Eustream s.a.), the Czech Republic (NET4GAS s.r.o.) and Germany (Open Grid Europe GmbH). Launched in September 2021, the project 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 based on existing gas pipelines. The length of the corridor will be approximately 1446 km. As far as Ukraine is concerned, this project is included in the TYNDP 2022 as the project HYD-N-1137 "Central European Hydrogen Corridor (Ukr part)", which is being implemented by the GTS Operator of Ukraine LLC. According to the decision of the European Commission¹⁴⁰, this project is included in the PCI/PMI list as a generic corridor under number 10.4. The project is currently preparing a Pre-Feasibility Study, with a deadline of June 2024.

This corridor could potentially serve the export of hydrogen production projects in Zakarpattia. On the Ukrainian side, there are no plans to develop a hydrogen corridor along the route of the Trans-Balkan gas

¹³⁷ Commission Delegated Regulation (EU) 2023/1184 of February 10, 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.

¹³⁸ Read more about these requirements:

https://www.dena.de/fileadmin/dena/Publikationen/PDFs/2023/STUDY_Establishing_a_National_Hydrogen_Standard.pdf

¹³⁹ <https://www.cehc.eu>

¹⁴⁰ 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.

pipeline (the demand for the capacity of this gas pipeline towards Ukraine determines its further use for the transportation of natural gas).¹⁴¹

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

The use of oil transport for hydrogen transportation over certain types of distances is currently one of the most promising areas of research involving European companies.¹⁴² At the EU level, relevant research is often funded by public funds (e.g., the UNLOHCKED project (Spain),¹⁴³, the SHERLOHCK project (France)¹⁴⁴, the HYSTOC project (Germany)).¹⁴⁵

JSC Ukrtransnafta has no experience in conducting research or activities aimed at determining the possibility of using the existing oil pipeline system to transport hydrogen in the form of liquid organic hydrogen compound (LOHC). At the same time, it is necessary to involve the company in the promising area of research and industrial use of the existing infrastructure for hydrogen transportation.

3) *Transportation by ammonia pipeline.*

The ESU also notes the expediency of using the Togliatti-Odesa ammonia pipeline, which runs through 6 regions of Ukraine (Kharkiv, Dnipro, Zaporizhzhia, Kherson, Mykolaiv, Odesa regions) and branches to Horlivka (Donetsk region), for the transportation of ammonia produced from hydrogen to Odesa (Odesa Port Plant). The ammonia pipeline is operated by Ukrkhimtransammonia. Currently, the beginning of the ammonia pipeline is located in the area of active hostilities.

ii. If applicable, major envisaged infrastructure projects other than projects of common interest (PCI)

Electricity infrastructure

The list and description of the key projects of Ukraine for the development of the electricity transmission system in terms of the development of internal trunk networks is contained in the Transmission System Development Plan for 2023-2032, developed by the TSO and approved by the Regulator (NEURC).¹⁴⁶ The projects of technical modernization and development of the transmission system are primarily aimed at improving the reliability of the system and security of electricity supply by releasing the locked capacities, removing internal system constraints, and reducing the level of technological electricity consumption during transmission.

In accordance with the Transmission System Development Plan for 2022-2031, Ukrrenergo has developed a comprehensive program of reconstruction, modernization and automation of substations, which envisages a phased reconstruction of all substations of the transmission system, with the introduction of automated process control systems. For the first stage of the Program, substations that supply power to administrative centers and large industrial enterprises were selected. The service life of these substations and the equipment installed on them exceeds 35 years, which is beyond the projected service life. When selecting the reconstruction sites, we took into account the prospects for the development of distribution systems in

¹⁴¹ ACER points out the potential problems of availability of gas transmission capacities during the conversion of a part of them to hydrogen transportation. See Opinion No.06/2023 of July 14, 2023 on the ENTSOG draft Ten-Year Network Development Plan 2022, para 57.

¹⁴² 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, Vol. 278, Part A, 2023, 127673, ISSN 0360-5442, <https://doi.org/10.1016/j.energy.2023.127673>.

¹⁴³ https://www.clean-hydrogen.europa.eu/projects-repository/unlohcked_en

¹⁴⁴ <https://cordis.europa.eu/project/id/101007223>

¹⁴⁵ <https://cordis.europa.eu/project/id/779694/factsheet>

¹⁴⁶ <https://zakon.rada.gov.ua/rada/show/v0266874-23#Text>

the respective regions, their infrastructure, and environmental and social risks for the population. The schedule of the first stage of substation reconstruction was drawn up, taking into account the possibility of ensuring the uninterrupted operation of the IPS of Ukraine without a critical decrease in the reliability of the power system's nodal substations. The schedule of automation of substations in the second stage is based on the possibility of equipment decommissioning and the availability of already reconstructed substations. The project is financed by loans from international financial institutions (IBRD, EIB, German Government, and KfW).

Table 2.10: Projects under the Program for Reconstruction, Modernization, and Automation of Ukrenergo Substations (pre-war assessment)

Project name	IFI	Substations	Years of completion
Substations reliability improvement program	EIB	11 330 kV substations 1 750 kV substation	2024-2025
Modernization of Ukrenergo's transmission network	EBRD	9 330 kV substations 1 400 kV substation 2 750 kV substations	2024-2025
Improving energy efficiency in power transmission (reconstruction of transformer substations) - II	KfW	7 330 kV substations 1 750 kV substation	2025
The second electricity transmission project	IBRD	2 220 kV substations 18 330 kV substations 1 750 kV substation	2022-2025
Improving the efficiency of electricity transmission	KfW	2 330 kV substations	2022
Reconstruction of substations in eastern Ukraine	KfW	2 330 kV substations 2 750 kV substations	2023
Construction of OHL 750 kV RNPP-Kyivska.	EIB	1 330 kV substation	2023

The key effects of the implementation of the Program for the reconstruction, modernization and automation of TSO substations are as follows:

- Improving the reliability of transmission system substations by using modern, cost-effective, highly reliable and environmentally friendly equipment that will ensure sustainable operation of substations in compliance with the criteria for grid stability and electricity quality indicators;
- replacing outdated switchgear that uses oil and air as insulating agents with modern gas-insulated equipment will reduce electricity consumption at substations by 3-5 times.
- replacement of relay protection and emergency automation devices from electromechanical to microprocessor-based ones will reduce the power consumption of each panel (cabinet) by up to 10 times.

Overall, the reduction in electricity consumption for the substations' own needs is expected to be around 30-35%. In addition, all 110-330 kV air circuit breakers are to be replaced with gas-insulated ones. The total estimated cost of implementing the Program for improving the reliability of substation equipment, overhead lines and relay protection devices operated by Ukrenergo is UAH 636.4 million (in 2020 prices).

In order to modernize the telecommunication network and ensure the transmission of information via high-speed flows between the power facilities of the IPS of Ukraine, Ukrrenergo envisages the development of fiber-optic communication lines (FOCL) in the projects of new construction, reconstruction and technical re-equipment of transmission system facilities. In order to ensure reliable operation of the IPS of Ukraine and operational security criteria of the transmission system, taking into account information security challenges, the TSO is implementing the information technology development program (through roadmaps) with the implementation period of 2019-2025 in the following areas: "IT solutions for reliable dispatching of the IPS of Ukraine", "Information security", "IT infrastructure and transfer of technological information", "Automation of business processes", "Service-oriented organization of IT processes").

The following programs have been approved and are being implemented to improve the reliability of substation equipment, overhead lines and relay protection devices operated by Ukrrenergo:

- Program for the phased replacement of potentially hazardous current transformers of the TFRM-330 and TRN-330 types manufactured by ZZVA CJSC for the period 2021-2025 (the estimated cost of the program is UAH 102.7 million in 2020 prices);
- The program for the phased replacement of defective reinforced concrete poles and lightning protection cable of NPC Ukrrenergo for the period 2021-2025 (the estimated cost of the program is UAH 441.8 million in 2020 prices);
- Program for the phased replacement of RF command transmission equipment and protection posts for the period 2021-2025 (estimated cost of the program is UAH 91.9 million in 2020 prices).

Oil and gas transportation infrastructure

See above section 2.4.2.i.

2.4.3. Market integration

The EU's energy policy priorities set out in the REPowerEU plan include several components that have significantly influenced the importance of gas as an energy resource for the transition to a carbon-neutral economy in 2050. Many EU Member States, in particular those with domestic natural gas production and/or significant gas dependence, explicitly recognize the key role of gas in meeting energy needs in the medium term in their national energy and climate plans. This recognition is accompanied by a number of policies and measures related to natural gas and oil, including

- Increase of own production, including development of continental shelf resources (Romania, Italy);
- new construction, modernization and optimization of infrastructure to increase cross-border flows, including capacity enhancement of domestic systems (Romania, Italy, Bulgaria).

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

At the same time, other countries set 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 consumption reduction are evident, and therefore such measures are being taken:

- establishing specific goals, responsibilities 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 gas infrastructure for hydrogen or carbon dioxide transportation/storage (Netherlands) or implementing research projects in this area (Italy).

Ukraine should take these approaches into account when formulating its short- and medium-term energy policy. The presence of significant natural gas production, the largest in the EU, and a wide-ranging system of natural gas transportation, storage, and distribution provides both opportunities and additional obstacles on the path to decarbonization in incredibly difficult conditions.

On the one hand, in the period up to 2030 Ukraine will be able to meet a significant part of its energy needs with domestically produced gas. In addition, there may be a resource for exporting natural gas to the EU. On the other hand, Ukraine needs to make preparations to reduce natural gas consumption in favor of gas and other types of energy from renewable or alternative sources. Thus, policies and measures to develop the internal market should address not only electricity but also gas. These policies and measures should generally ensure:

- access of gas consumers to reliable and affordable energy;
- Reducing consumption of all types of energy, including gas;
- increasing the share of gas from renewable or alternative energy sources in total gas consumption;
- Increase competition in the relevant markets and allow consumers to benefit from liberalized markets;
- creating the necessary conditions and providing the right incentives and signals to natural gas market players to prepare for work 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 competitive electricity prices in accordance with relevant sectoral law, integration and interconnection of markets to increase the capacity of existing interconnectors for sale, smart grids, aggregation, demand management, energy storage, distributed generation, dispatch, redispatch and curtailment mechanisms, price signals in the real-time market, and

Full and comprehensive integration with European energy markets

The ESU contains a strategic goal of full and comprehensive integration of Ukraine's energy markets with European markets by ensuring legal, technical and economic synchronization, accompanied by increased trade opportunities between neighboring countries, increased competition and efficient functioning of the internal market. At the same time, it is envisaged to develop an export-oriented energy sector.

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

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

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

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

Formation of market-based energy prices for all categories of consumers

The NES defines among its target indicators under strategic objective 3 "Ensuring the functioning of free, efficient and competitive markets" the goal of establishing a market-based energy price for all categories

of consumers with effective mechanisms to support vulnerable groups of the population, as well as ensuring the absence of a debt burden on energy market players.

According to the Law of Ukraine "On the Natural Gas Market" (Article 12(2)), natural gas is supplied at prices freely determined between the supplier and the consumer, except as 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 to export and import it at free prices (Article 55). Also, electricity is supplied to consumers 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 setting that reflects economically justified costs.¹⁴⁷

Similarly, the ESU is based on the principle of marketability, 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, re-dispatching and curtailment, real-time price signals

According to the Concept for the Implementation of Smart Grids in Ukraine by 2035, it is planned to introduce smart metering of electricity in 2022-2035. As part of the eConsumer initiative and with the construction of smart grids, it is planned to ensure 100% commercial metering in energy markets, automatic reading and transfer to the consumption metering system (CMS). As a result, consumers should be able to manage their electricity consumption, and reduce energy costs without compromising their lifestyle and excessive restrictions on electricity consumption to meet household needs. The possibility of aggregation activities is also provided for at the legislative level (see Section 3.4.3.iii).

According to the ESU, the modernization of the power grids is expected to reduce power outages in the long term to 150 minutes in urban areas and 300 minutes in rural areas, according to the SAIDI (average duration of power outages) indicator.

The expected to reduce the index of electricity not supplied by at least 3 times by 2030.¹⁴⁸

One of the key principles of the ESU 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 ESU defines the restoration of damaged energy infrastructure facilities with a focus on minimizing GHG emissions by means of:

- development of renewables, which includes a set of measures for the construction of wind power plants, wind generation and promotion of distributed solar generation to cover own 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 is to increase the share of electricity and heat production from RES. In particular, the share of RES in the electricity generation structure should be more than 25% by 2032.

According to the conclusions of the Report on the Assessment of Conformity (Sufficiency) of Generating Capacities, in order to cover the projected electricity demand and provide the necessary reserve in 2023, to increase the flexibility of the power system, maintain and restore frequency, it is necessary to build up to 0.8 GW of SPP (with a total energy capacity of 2 GWh or more) with technical characteristics that meet the requirements of the Transmission System Code in the near future, provided that RES are involved in

¹⁴⁷ <https://zakon.rada.gov.ua/laws/show/2019-19#Text>

¹⁴⁸ <https://zakon.rada.gov.ua/laws/show/908-2022-%D1%80#Text>

balancing the power system and providing reserves. Without the involvement of RES in the regulation or unloading of NPP capacities during surplus periods, the need for EPS in the power system may exceed 2 GW.¹⁴⁹

ii. If applicable, national targets for the non-discriminatory integration of renewable energy sources, demand side management and energy storage, including through aggregation, in all energy markets, including timeframes for achieving the respective targets

Electricity market

The Law of Ukraine "On the Electricity Market" provides for non-discriminatory participation in the electricity market by all its participants, in particular in terms of licensing, access to networks and congestion management, allocation of cross-border capacity, tender procedures for attracting new investments in generating capacities, dispatch (operational and technological) control of the power system, purchase of balancing services, price and tariff setting, electricity supply, etc. At the same time, Ukraine did not set special goals in terms of non-discriminatory integration of RES, demand management, energy storage, and aggregation.

Natural gas market

The ESU includes tasks for implementing biomethane production projects and overcoming obstacles to the effective development of such production.

In addition, in accordance with 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 an energy regulator include, in particular:

- applying the natural gas market legislation to biogas or other types of gas from alternative sources on a non-discriminatory basis; promoting safe, reliable and economical functioning of the gas infrastructure (gas transmission and distribution systems, gas storage facilities and LNG plants), which will allow gas producers from alternative sources to enter the natural gas market regardless of production volumes;
- ensuring simple and non-burdensome conditions for connection to gas transmission and distribution systems for new customer facilities, ensuring simple and non-burdensome conditions for access to gas transmission and distribution systems, gas storage facilities and LNG facilities for new customers, including the removal of barriers that may prevent such access for new wholesalers or suppliers, as well as for wholesalers or suppliers of gas 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 the promotion of the development and rational use of non-traditional 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 imports.

The ESU also notes the need to take measures to promote the use of biomethane as a motor fuel, adopt European standards for the use of biomethane in the transport sector, introduce a mechanism to stimulate biomethane production, and introduce benefits for profits reinvested in production.

iii. National targets for ensuring consumer participation in the energy system and benefits from self-generation and new technologies, including smart meters

¹⁴⁹ <https://zakon.rada.gov.ua/rada/show/v0664874-23#Text>

Electricity market

Ukraine has not set any special goals in terms of ensuring consumer participation in the operation of the power system, benefiting from self-generation and new technologies, including smart meters. At the same time, the ESU provides for all consumers to be able to interact with all electricity service providers through the introduction of smart metering systems, automatic reading and transmission of consumption data. The legislation also provides for a model of participation in the electricity market by active consumers¹⁵⁰ through the mechanism of self-production and other means.¹⁵¹

Natural gas market

Ensuring 100% of gas metering

The NES includes a goal to ensure the installation of gas meters and the installation of a system for remote metering and automation of natural gas balancing. According to the NES, more than 1 million gas consumers do not have individual metering devices, which makes it impossible to monitor gas consumption and does not create incentives for economical consumption. Thus, a significant number of household consumers are not even equipped with conventional meters (according to the data for 2021, which is likely to remain relevant). The relevant specific goal is set by the Law of Ukraine "On Ensuring Commercial Metering of Natural Gas", according to which the deadline for equipping all consumers with meters is 01.01.2023. The Verkhovna Rada of Ukraine is currently considering a draft law that would postpone this deadline to 01.01.2028.

Reliability and completeness of commercial gas metering

The ESU sets out to improve the quality of commercial gas metering.

The commercial gas metering system is generally used to determine the data on gas quality and quantity to be used in settlements between gas market participants. The relevant data should be generated on the basis of metering data, but the latter is often not available: this refers to situations where a gas meter (metering unit) is missing, faulty, or cannot be promptly transmitted to market participants for mutual settlements.

In general, many (but not all) commercial metering problems could be solved by providing 100% metering with meters with remote data transmission capabilities. However, firstly, the decision to equip all consumers with such advanced tools and systems requires a comprehensive assessment of benefits and costs, as well as the allocation of funds, and secondly, even if such a solution is available, its implementation will take a long time. Finally, there may still be situations where the metering data is not available.

The commercial accounting system should perform several functions¹⁵²:

- clearly identify the entity that owns the gas volumes transferred/delivered/used;

¹⁵⁰ Active consumer means a consumer, including a private household, an energy cooperative, and a consumer who is a customer of an energy service that consumes and produces electricity, and/or carries out energy storage activities, and/or sells surplus electricity produced and/or stored, or participates in energy efficiency and demand management activities, provided that these activities are not professional and/or business activities.

¹⁵¹ <https://zakon.rada.gov.ua/laws/show/2019-19#Text>

¹⁵² There are problems in all these areas in Ukraine. Since 2015, a large number of court disputes have been related to the distribution of supplied/used gas between market participants (GTS operator, DSOs, PSO supplier, district heating companies, and the supplier of last resort). For the purposes of commercial balancing, data transmitted by consumers or determined by calculation are used, while the method of calculating these data raises many questions; most of the data on which the calculations are based are substitution data, not actual data. As a result of the control reconciliation of readings conducted by the DSO at least once every 6 months, the relevant commercial metering data are not adjusted; not all DSOs fulfill their obligation to conduct regular control reconciliations. Consumption data is accumulated at the level of DSOs, and there is a high risk of losing this data, as no public authority defines requirements for the storage of this data and the exercise of consumer rights in relation to it.

- ensure the determination of the volume of gas transferred/delivered/used;
- if metering data is not available at a certain time, use substitution data generated in a transparent and reasonable manner, taking into account available metering data in other periods;
- Ensure a constant flow of data, its reliability and secure storage, including responding to serious discrepancies between actual volumes and volumes used in calculations;
- resolve disputes over accounting data that may arise between market participants, including in view of their conflicting interests;
- create incentives for the development of competition in the retail gas market (according to Directive 2009/73/EC, consumers should have the right to dispose of their consumption data by transferring it to the supplier or other persons of their choice).

iv. National targets for ensuring the adequacy (sufficiency) of the energy system, as well as the flexibility of the energy system in terms of RES production, including deadlines for achieving the relevant targets

Electricity market

Ensuring the power system adequacy

The ESU envisages that the growth in electricity demand will be covered primarily by carbon-neutral sources (RES and nuclear generation). Since wind farms and solar power plants are non-guaranteed capacity, they will be balanced in the system by the government:

- flexible capacities of HPPs and PSPPs;
- balancing and reserve capacities - combined-fuel TPPs (natural gas and/or biomethane) and, in the future, other technologies with similar technical parameters;
- increasing the capacity of the UES, including long-term (seasonal) storage facilities using Power-to-X technology (hydrogen, ammonia, etc.).

According to the ESU forecasts, the total available capacity of power plants in the IPS of Ukraine may increase to 62.9 GW by 2032 (NPPs - 17.4 GW, CHPs - 2.5 GW, WPPs - 10.1 GW, SPPs - 12.6 GW, HPPs - 4.9 GW, PSPs - 4.1 GW, TPPs - 1.1 GW, bio TPPs - 0.3 GW, semi-peak and peak generation - 9.4 GW, and CCS - 0.5 GW). In particular, the share of nuclear generation is projected to remain at about 56% of the overall electricity production in the IPS of Ukraine in 2050. To replace coal generation, TPP and CHP using natural gas/biomethane or other technologies with similar characteristics will be used.

Increase system flexibility

The IPS of Ukraine does not have a sufficient level of flexibility and will need to be gradually increased to ensure proper integration of power plants with non-guaranteed capacity based on renewable energy sources (solar and wind power plants) into the power system by 2030 and beyond.

According to the conclusions of the Report on the Assessment of the Adequacy of Generating Capacities, the IPS of Ukraine does not meet the requirements for the compliance of generating capacities to cover the projected electricity demand and ensure the necessary reserve in 2023, and with the further increase in power plants with non-guaranteed capacity based on renewable energy sources, the problems of ensuring operational security will become more acute.

The commissioning of highly maneuverable facilities with the ability to start up quickly (start-up from scratch and reaching the rated capacity in 10-15 minutes) and fast-acting reserves based on electricity storage facilities (ESP) will provide the IPS of Ukraine with the necessary regulation reserves to meet compliance requirements in the future.

According to Ukrrenergo's estimates set out in the Report on the Assessment of the Suitability (Adequacy) of Generating Capacities to Cover the Forecasted Electricity Demand and Ensure the Necessary Reserve in 2023,¹⁵³ the power system needs to be built in the near future to increase its flexibility:

- at least 1.4 GW of highly maneuverable capacities with a quick start (full activation from a stopped state - no more than 15 minutes, the ability to start and stop at least four times a day with a control range of at least 80% of the installed capacity). To maximize electricity production from RES and minimize its curtailments, it is advisable to build at least 2.4 GW of highly maneuverable capacities;
- 0.8 GW of BESS (with a total energy capacity of 2 GWh or more) with technical characteristics that meet the requirements of the Transmission System Code - provided that RES are involved in balancing the power system and reserves are provided. Without involving RES in balancing or curtailing NPP capacities during surplus periods, the need for BESS in the power system may exceed 2 GW.

Natural gas market

Achieving sufficient domestic production volumes

The NES envisages "meeting 100 percent of Ukraine's natural gas needs through domestic production" as a target indicator for 2030. The ESU sets two objectives - on the one hand, self-sufficiency, and on the other hand, building an export-oriented energy industry, of which the export of Ukrainian gas to the EU is an element. In this regard, the ESU envisages natural gas exports as a task by 2050, noting that the forecast of domestic production by 2032 is 21.5 billion m³ under the baseline scenario and 26.8 billion m³ under the optimistic scenario. In addition, the Law of Ukraine "On Approval of the National Program for the Development of the Mineral Resource Base of Ukraine for the Period up to 2030" sets the goal of increasing oil and condensate and natural gas reserves to 72.5 million tons and 287.0 billion m³, respectively, by 2030.

At the same time, the Energy Security Strategy envisages *a reasonable* increase in energy production as a priority task under Strategic Objective 3 "Economic efficiency of the energy sector, energy supply systems and import substitution of mineral raw materials".

The increase in natural gas production should be aimed at achieving the ESU targets, taking into account the need for significant investments required for exploration and development of gas fields, the possibility of alternative use of funds (including lost state budget revenues from tax benefits and discounts) and the principle of energy efficiency priority, as well as the prospects for the development of natural gas consumption in Ukraine and the EU.

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

The NES contains the goal of establishing a market-based energy price for all categories of consumers with effective mechanisms to support vulnerable groups of the population.

According to the Law of Ukraine "On the Natural Gas Market", one of the principles of the natural gas market is to ensure a high level of protection of the rights and interests of natural gas consumers, including ensuring the primary interest of security of natural gas supply, in particular by diversifying sources of

¹⁵³ <https://www.nerc.gov.ua/news/nkrekp-zatverdila-zvit-z-ocinki-vidpovidnosti-generuyuchih-potuzhnostej-dlya-pokrityya-prognozovanogo-popitu-na-elektrichnu-energiyu-ta-zabezpechennya-neobhidnogo-rezervu-u-2023-roci>

natural gas supply. Articles 12-14 of the same Law define the basic rights of consumers, including minimum contractual terms, information to be placed on payment documents, the right to change the supplier, etc. The main tasks of the Regulator include promoting a high level of fulfillment of special duties to ensure the public interest in the natural gas market, protecting vulnerable consumers and establishing the data exchange process necessary for consumers to exercise their right to change supplier.

According to the Law of Ukraine "On the Electricity Market" (Articles 60, 61), in order to ensure the protection of consumer rights, electricity market participants may not use unfair methods of competition against consumers. The terms and conditions of contracts with consumers must be transparent and easy to understand. Electricity shall be supplied on a non-discriminatory basis, and consumers shall be disconnected exclusively in accordance with the procedure established by this Law and the rules of the retail electricity market. Disconnection of protected consumers shall be carried out in compliance with the requirements of the procedure for ensuring the supply of electricity to protected consumers.

Vulnerable consumers are eligible for support to reimburse the costs of paying for consumed energy resources in accordance with the Laws of Ukraine "On the Electricity Market" and "On the Natural Gas Market". Additional assistance is provided for the purchase of solid household stove fuel, namely firewood and coal.¹⁵⁴

At the same time, according to the NEURC, there is significant concentration in the wholesale and retail natural gas markets. Given the administrative control of prices for household consumers, the dynamics of supplier switching is low. Martial law and energy security challenges have a significant impact on market development.

According to the recommendations of the European Commission¹⁵⁵, energy markets should be monitored using the following parameters:

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

Other specific indicators can also be used, the choice of which can be adapted to the specifics of the domestic market¹⁵⁶. Despite the fact that both the NEURC itself and the Energy Community Regulatory Board often use relevant indicators, they are not fixed at the state level as goals.

Pursuant to Article 20 of the Law of Ukraine "On the NEURC", the NEURC monitors the functioning of the energy and utilities markets. At the same time, the Procedure for Monitoring the Energy and Utilities Markets by the National Energy and Utilities Regulatory Commission, approved by Resolution No. 1120 of the NEURC dated 14.09.2017, provides that in the process of monitoring markets, an indicator/indicator is determined for each subject of monitoring with indication (where applicable) of target (set) values or permissible range of values, and target (set) values of indicators/indicators are determined by the current legislation and decisions

It is proposed that by the 1st quarter of 2025, the NEURC defines key indicators and target values for each monitoring subject, which will allow analyzing the effectiveness of the policies and measures listed in Section 3.

¹⁵⁴ <https://zakon.rada.gov.ua/laws/show/1173-2023-%D0%BF>

¹⁵⁵ COM(2019) 285 final, 18.06.2019, p. 22; SWD(2015) 243 final, 18.11.2015, pp. 32-43.

¹⁵⁶ European Gas Target Model (for the wholesale market); 2017 Handbook for National Energy Regulators: How to assess retail market functioning, Ref: C16-SC-52-03, January 24, 2017 (for the retail market).

2.4.4. Energy poverty

If applicable, national targets for reducing energy poverty, including timeframes for achieving the relevant targets

Reducing energy poverty, protecting vulnerable consumers, and promoting gender and social inclusion are strategic goals of the ESU. 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 European average of 7.9%.

The ESU defines energy poverty as a situation where the cost of energy consumed by a household consumer makes up a large part of their income, which leads to the inability to pay for the cost of energy consumed and/or reduce its consumption and, in turn, negatively affects the quality of life. At the same time, there is currently no such definition at the legislative level, as well as no quantitative and qualitative indicators that give grounds to classify people as energy poor.

2.5. Dimension "Research, Innovation and Competitiveness"

i. National targets and funding targets for public and, where available, private research and innovation related to the Energy Union, including, where appropriate, timeframes for achieving the respective targets

According to the International Energy Agency, "accelerating the innovation process is crucial to achieving zero emissions by 2050, and policies will play a crucial role in this regard. Almost half of the emission reductions needed to reach zero emissions in 2050 will come from technologies that are not yet out of the demonstration phase. This is especially true for sectors that remain stubbornly dependent on fossil fuels, such as intercity transportation and heavy industry. The goal of achieving zero emissions by 2050 will be unattainable without significant innovation efforts to improve and commercialize known technologies this decade, as well as bring less mature ideas to market as quickly as possible to minimize the costs of the energy transition."¹⁵⁷

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

- National Economic Strategy for the period up to 2030¹⁵⁸
- Strategy for the development of the innovation sector for the period up to 2030¹⁵⁹
- Energy Strategy of Ukraine until 2050
- Concept for the Implementation of Smart Grids in Ukraine until 2035¹⁶⁰ (*Concept for the Implementation of Smart Grids in Ukraine until 2035*, 2023)

¹⁵⁷ 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>

¹⁵⁸ "On Amendments to the National Economic Strategy for the period up to 2030"

<https://zakon.rada.gov.ua/go/202-2021-%D0%BF>

¹⁵⁹ Strategy for the Development of the Innovation Sector for the Period up to 2030
<https://zakon.rada.gov.ua/laws/show/526-2019-%D1%80#Text>

¹⁶⁰ Concept of implementation of "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>

- Law of Ukraine "On Priority Areas of Science and Technology Development"¹⁶¹
- Law of Ukraine "On Priority Areas of Innovation Activity in Ukraine"¹⁶²

It should be noted that there is another public policy program document that defines innovations in the field of energy and climate change - the National Low Carbon Development Strategy. However, since this document has not passed all stages of approval since its development in 2021, the priorities set out in it will be included in the next NECP of Ukraine.

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

- Innovative technologies or approaches should be used
- State support for innovation development is needed
- Requires state support in one form or another

Among the expected results of implementation, the following are directly related to innovation and competitiveness:

defining and public support for the state's strategic course in the economic sphere, the consistent implementation of which will allow

- to formulate **competitive business and investment frameworks** and restore trust in the state;
- to become **competitive in the international market**;
- **to stimulate the development of innovation and modernization of economic sectors** to ensure competitive ability in the international market;
- ensure the **development of human potential** and win the **competition for talents**;
- ensure **equal rights and opportunities for women and men** in all spheres of society.

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

- decarbonization of the economy (improving energy efficiency, developing renewable energy sources, developing a circular economy and synchronizing with the European Green Deal initiative);
- [...]
- development of entrepreneurship, innovation and talent;

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

[...]

- monopolization of competitive markets;
- unfair use of economic incentives;

¹⁶¹ Law of Ukraine "On Priority Areas of Science and Technology Development" <https://zakon.rada.gov.ua/laws/show/2623-14#Text>

¹⁶² The Law of Ukraine "On Amendments to Certain Laws of Ukraine on Priority Areas of Science and Technology Development and Innovation Activities" <https://zakon.rada.gov.ua/laws/show/3534-20#n6>

- retreat from reforming underdeveloped markets;
[...]
 - environmental degradation.
-

The National Economic Strategy, in particular, defines the following tasks under the strategic goal "Ensuring mutually beneficial trade with countries of the world and achieving expanded access to foreign markets."

- formulation of an individual approach to applying the Carbon Border Adjustment Mechanism (CBAM) to Ukraine as a state that has committed itself to political association and economic integration with the EU under the EU-Ukraine Association Agreement
- agreeing with all stakeholders on the parameters of revision of Annexes XXX and XXXI to the EU-Ukraine Association Agreement (environmental protection and climate)

Also, the National Economic Strategy (NES) of Ukraine for the period up to 2030¹⁶³ provides a wide range of measures targeting various sectors of the economy that will require the implementation of research and innovation projects to maintain the competitiveness of the Ukrainian economy. In particular, the NES vision for ICT states that "Ukraine is [...] a European center for research and development".

The strategic goal of the NES "**Creating new production capacities by stimulating innovative activities of enterprises in all regions of the country using the competitive advantages of each of them**" lists the following challenges:

- high cost and time-consuming connection of production facilities to the power grid (the cost of connecting to the power grid in Ukraine is several times higher than in the EU);
- low level of R&D funding (investment in low-tech production and low R&D spending);
- Lack of close cooperation between scientific institutions and industrial enterprises (detachment of Ukrainian science from the real needs of industry and lack of effective cooperation between science and industry);

The National Economic Strategy also draws attention to 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 manufacturing industry. In 2017, Ukraine's GDP per unit of total primary energy supply reached USD 5,054, which is close to the countries of Eastern Europe, the Caucasus and Central Asia. However, Ukraine is characterized by an annual increase in generated GDP per unit of total primary energy supply (on average by 100-200 USD). Poland generates USD 10,620 (twice as much) per 1 thousand tons of oil equivalent, and in the EU countries the average is 2.53 times higher (USD 12,802) than in Ukraine."

The National Economic Strategy attaches a significant role to the energy sector, in particular, it sets out significant ways to achieve the strategic goal of "Ensuring the functioning of a smart, modernized and

¹⁶³ "On Amendments to the National Economic Strategy for the period up to 2030"
<https://zakon.rada.gov.ua/go/202-2021-%D0%BF>

reliable energy system that fully meets the requirements and needs of end users" in terms of research, innovation and competitiveness:

Ways to achieve the Objectives.
strategic goal

1. Modernization and [...]

optimization of facilities

- Regulation of distributed generation aggregators and balancing service providers
 - [...]
 - Ensuring an increase in the volume of energy storage capacities - a battery system for storing electricity
 - Consideration of the possibility of hydrogen production using excess electricity in the system for further export of hydrogen to the EU
 - Regulation of the operation of localized generation from renewable energy sources that connects directly to consumer networks without paying for the distribution and transmission of electricity
- [...]
-

2. Promoting infrastructure development

- Support for the reconstruction and development of distribution networks in line with the development of distributed power generation
 - Development and implementation of economically feasible projects to optimize and modernize gas distribution networks in accordance with the needs of the economy, reconstruction of the necessary outdated networks and preparation of gas distribution networks for hydrogen transportation
 - [...]
 - Release of locked-in capacities as a result of the grid development program and projects aimed at removing internal constraints
 - Provide a clear definition of the purpose and limits of the small distribution system
 - [...]
 - Consideration of the issue of creating infrastructure to ensure Ukraine's integration into the hydrogen economy
 - [...]
 - Supporting the reconstruction and development of distribution networks in line with the development of distributed power generation
-

The following tasks are envisaged as part of the ways to achieve the strategic goal "Improving the energy efficiency of the economy and ensuring the environmental friendliness of the energy sector":

Ensuring sustainable development

- Stimulating scientific organizations to conduct research in the field of energy efficiency and hydrogen technologies
 - Regulation of market, regulatory and technical opportunities for the production and export transmission of hydrogen from renewable energy
-

sources and nuclear power plants with a guaranteed price in euros and long-term contracts

In the National Economic Strategy, the strategic goal "Strengthening the competitiveness of industrial products manufactured in Ukraine, introduction of resource and energy efficient technologies", in particular, indicates that one of the ways to achieve the strategic goal of increasing resource efficiency with the following tasks:

- | | |
|--------------------------------------|--|
| Improving resource efficiency | <ul style="list-style-type: none">● Raising awareness of the implementation of resource-efficient technologies● Implementation of effective regulation in the field of resource conservation and use of renewable energy sources● Attracting grants and loans for resource and energy-saving technologies● Providing access to high-quality energy audits● Ensuring the implementation of energy management systems● development of sustainable public procurement by raising awareness of market participants and providing methodological support on the application of sustainability criteria● introducing a system of tax incentives for eco-modernization● Implementation of a system of trading in greenhouse gas emission quotas and other instruments for setting the price of greenhouse gas emissions● Implementation of the best available technologies and management practices |
|--------------------------------------|--|
-

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

- | | |
|--|---|
| Stimulating the development of the circular economy | <ul style="list-style-type: none">● creating transparent and competitive markets for secondary raw materials by improving and harmonizing Ukrainian legislation with relevant EU legislation and rules and regulations● stimulating the reduction of waste generation● Simplification of the procedure for conducting operations with scrap metal● formulation of circular economy policy● introduction of a system of extended producer liability● Implementation of a set of measures for the commercial development of industrial waste heaps |
|--|---|
-

Another strategic goal relevant to the National Energy and Climate Plan within the framework of the National Economic Strategy is Goal 4 "Creation of new production capacities through stimulating innovative activities of enterprises in all regions of the country using the competitive advantages of each of them", which refers to the ways to achieve the introduction of innovative technologies with the following objectives:

Implementation innovative technologies	of	<ul style="list-style-type: none"> ● creating a platform for sharing experience in the implementation of innovative technologies ● Improving the mechanism for commercialization of scientific and technical developments and research and development ● reducing the risk of implementing innovative projects through insurance instruments for such projects ● Creating favorable conditions for cluster development ● building relationships and strengthening cooperation between higher education institutions, research centers and industry ● Integration of Ukrainian industrial clusters with the European Cluster Collaboration Platform ● creation of scientific and technical clusters with the participation of basic enterprises ● implementation of the best available technologies in accordance with EU Best Available Techniques reference documents
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Goal 4 also focuses on Industry 4.0 and related research and innovation projects:

Implementation Industry 4.0	of	<ul style="list-style-type: none"> ● popularization of the Industry 4.0 concept and its individual elements as a mandatory factor for 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 Industry 4.0 concept at the expense of EU funds, in particular, under the European Union's Horizon Europe Framework Program for Research and Innovation (2021-2027) ● promoting educational activities on the transfer of best practices from the IT sector to industrial sectors ● Ensuring the integration of Industry 4.0 innovations into the defense and security strategies of the country ● formation of new competencies of personnel in industry for the purpose of introducing digital technologies ● full-scale digitalization of key industry sectors ● ensuring clustering in the field of Industry 4.0 - at the national and regional levels
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The strategic course of policy in the field of agricultural sector development defined in the NES provides for several ways to achieve the strategic goal "Ensuring stimulating and advisory agricultural policy", which are relevant to the NEC:

State policy in the agricultural sector on	the	<ul style="list-style-type: none"> ● Approximation of national legislation, standards and practices to the European principles of sustainable agriculture policy and good
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environmental protection and natural resource management in agriculture	agricultural practices, gradual harmonization of state agricultural policy with the EU Green Deal in agriculture <ul style="list-style-type: none"> ● Development and monitoring of indicators of the impact of agricultural activities on the state of ecosystems ● Developing, promoting and monitoring compliance with minimum environmental standards ● Introduction of a national report on greenhouse gas emissions from the production and circulation of agricultural crops ● introducing economic incentives for land use and protection, improving soil fertility, reducing water and other environmental pollution from agricultural sources, improving the structure of the country's land and land use, restoring anthropogenically altered ecosystems, implementing sustainable land use and achieving a neutral level of land degradation
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Increasing the technological efficiency of monitoring the quality of land resources	<ul style="list-style-type: none"> ● conducting systematic monitoring of soil fertility and quality, introducing satellite monitoring ● Reforming the system of state research institutions, improving the quality and efficiency of scientific support for the agro-industrial complex, expanding research relevant to agricultural producers, strengthening innovation potential, deepening the integration of domestic research institutions into the international research community ● Ensuring the adjustment of crop cultivation technologies based on the results of navigation with the global positioning system and agricultural machinery
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The NES strategic goal "Balancing the production of high and low-margin products to increase the profitability of the [agricultural] sector" provides for:

Ensuring the development of sustainable production	<ul style="list-style-type: none"> ● Promoting sustainable agricultural production, environmental and animal protection, the use of organic production methods and biotechnology, climate-smart agriculture and forestry with greenhouse gas emission reduction and climate change adaptation, sustainable management of natural resources, and the conservation and enhancement of biodiversity
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The Strategy for the Development of the Innovation Sector of Ukraine until 2030 does not single out low-carbon sectors and technologies as one of the priority areas, but refers to the Low Carbon Development Strategy until 2050 as one of about 40 sectoral strategic documents related to the development of innovations in a particular area¹⁶⁴. At the same time, attention should be paid to the status of this document, which was supported and approved by the protocol decision of the Cabinet of Ministers of Ukraine on July 18, 2018¹⁶⁵ and published on the UNFCCC website¹⁶⁶, but is not available in the databases of official

¹⁶⁴ "On Approval of the Strategy for the Development of the Innovation Sector for the Period up to 2030" <https://zakon.rada.gov.ua/go/526-2019-%D1%80>.

¹⁶⁵ <https://mepr.gov.ua/diyalnist/napryamky/zmina-klimatu/pom-yakshennya-zminy-klimatu/strategiya-nyzkovugletsevogo-rozvytku-ukrayiny-do-2050-roku/>

¹⁶⁶ https://unfccc.int/sites/default/files/resource/Ukraine_LEDS_en.pdf

documents of Ukrainian state bodies. There is also a resolution of the Verkhovna Rada of November 5, 2021, No. 1870-IX¹⁶⁷, which, in particular, 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-Carbon Development Strategy of Ukraine for the period up to 2050".

Among the programmatic measures aimed at solving the problems of the innovation sector in Ukraine, the Strategy for the Development of the Innovation Sector calls for a review of the priority areas of science and technology development to bring them closer to those identified in developed countries based on modern global technological trends.

Given the extremely high priority of climate and low-carbon technology research in most highly developed countries, this tangentially confirms the trend toward the development of low-carbon technologies in the Ukrainian scientific and innovation sector.

The Innovation Development Strategy also includes the creation of experience exchange schools and national resources for entrepreneurship and innovation education, including a professional development network for both teachers and managers of higher education and research institutions, with the involvement of global experts, trainers, mentors, and the European Entrepreneurship Network (EEN).

The Innovation Development Strategy calls the introduction of European technical standards in Ukraine, as stipulated by the EU-Ukraine Association Agreement, one of the most transformative factors for the entire Ukrainian economy and for the low-carbon technology sector in particular.

The following indicators are listed among the indicators of the Strategy for the Development of the Innovation Sector of Ukraine (base year: 2017):

- the share of expenditures on **research and development in gross domestic product is 3%** (in 2017 - 0.45%);
- the share of **innovative enterprises** in the total number of enterprises is **at least 30%** (in 2017 - 16.2%);
- the share of **exports of goods produced by enterprises of the high- and medium-tech industry sectors** in the total volume of exports of goods is **30%** (in 2017 - 15.4%);
- the share of **employees** employed by enterprises belonging to the **high- and medium-tech sectors of industry** in the total number of employed workers in industry is **29%** (in 2017 - 21.3%);
- the share of **innovative products** sold in the total volume of industrial products sold was **10%** (in 2017 - 0.7%).

The Action Plan for 2021-2023 for the implementation of the Strategy for the Development of the Innovation Sector until 2030, approved by the Cabinet of Ministers of Ukraine on December 9, 2021, No. 1687-p, provides for several important steps for the low-carbon technology sector:

Promoting the development of a network of Industry 4.0 centers (Ministry of Economy, Ministry of Education and Science, Ministry of Regional Development, Ministry of Digital Transformation, Ministry of Strategy and Industry, industry and business associations (upon agreement)

Expected result:

- the competencies and capabilities of Industry 4.0 centers were expanded, and such centers cooperate with the network of Digital Innovation Hubs (DIHs)

¹⁶⁷ <https://zakon.rada.gov.ua/laws/show/1870-IX#Text>

Developing 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 (upon agreement))

Expected result:

- Technology and innovation support centers were established in all regions
- innovation entities have access to the patent database and receive basic consulting services

Providing financial support to higher education institutions and research institutions for innovation activities (MES)

Expected result:

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

Ensure information campaigns on the possibility of participating in national competitions and international innovation programs, on success stories of innovation activities (MES, Ministry of Digital Transformation, Ministry of Economy, Ministry of Regional Development)

Expected result:

- Increased awareness of innovators about opportunities to participate in domestic competitions and international programs, about success stories of innovation activities
- information days for innovators were held to inform them about the possibility of participating in the Horizon Europe program in terms of innovation support
- Information days for innovators were held to inform them about the possibility of participating in the EUREKA program

The Energy Strategy of Ukraine for the period up to 2050 sets among its strategic goals the target of "**Reduced energy intensity of GDP by 50 percent through an effective energy use policy**".

In making assumptions about the energy intensity of individual industries, the ESA is guided by the indicators listed below:

- Extractive industry: 21% reduction in energy intensity by 2032 compared to 2023.
- Manufacturing industry: the main changes will be in the metallurgy (51% reduction in energy intensity by 2050) and machine building sectors (50% reduction), while gas consumption will decrease due to hydrogen substitution.
- Services sector: the transition to the use of renewable energy sources, natural gas and electricity will reduce specific energy consumption by 22% by 2032 and halve it by 2050 (compared to 2023).

The Concept for the Implementation of Smart Grids in Ukraine until 2035, approved by the Cabinet of Ministers of Ukraine on October 14, 2022, No. 908-p, is a document that sets out the state's obligations in

the field of smart grid implementation. And despite the fact that the word "innovation" is used in this document only once, the entire Concept is devoted to the implementation of a set of technologies that are innovative in nature. An important feature of this document is that it pays considerable attention to the development of the smart grid:

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

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

The Concept notes that measures to implement "smart grids" require significant funding, but the Concept also states that the funding for the measures envisaged by the document should be provided by the government:

- Inclusion of measures to implement smart grids in the investment programs of regulated companies (distribution system operators, transmission system operators, electricity producers, and other sources not prohibited by law);
- Raising funds from donors and international financial institutions

The Concept is annexed to the Action Plan for the Implementation of the Concept of Smart Grid Implementation in Ukraine until 2035, which provides for the sequential implementation of 33 specific interrelated measures over the period of 2022-2035. The measures include both regulatory and organizational and technical measures, the timeframe for their implementation and the responsible public authorities are specified, and the expected results of the measures are determined.

ii. Where available, national 2050 targets related to the promotion of clean energy technologies and, where relevant, national targets, including long-term targets (2050) for the deployment of low-carbon technologies, including for the decarbonization of energy-intensive and carbon-intensive industries, and, where applicable, for related carbon transport and storage infrastructure

See Section 2.5.i. above, in particular with regard to certain indicators of the Energy Strategy of Ukraine until 2050.

iii. If applicable, national competitiveness objectives

See Section 2.5.i. above.

3. POLICIES AND MEASURES

3.1 Decarbonization dimension

3.1.1. GHG emissions and removals

i. Policies and measures to achieve the target set under Regulation (EU) No. 2018/842 as described in point 2.1.1, as well as policies and measures to ensure compliance with Regulation (EU) No. 2018/841, covering all key emitting sectors and sectors where removals need to be enhanced, taking into account the long-term perspective and the goal of becoming a low-carbon economy and achieving a balance between emissions and removals in accordance with the [Paris Agreement](#)

PM_D_WEM_01 Tax on carbon dioxide emissions

Objective: To stimulate the reduction of carbon dioxide emissions (in million tons of CO₂), to generate budget revenues (UAH million).

Legal basis: The Tax Code of Ukraine dated 02.12.2010 No. 2755-VI, the Budget Code of Ukraine dated 08.07.2010 No. 2456-VI

Timeline: since 2010

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

Description: The CO tax₂ in Ukraine was introduced in 2010 with the approval of the new Tax Code of Ukraine¹⁶⁸ . The CO₂ tax is an environmental tax levied on carbon dioxide emissions from stationary sources of pollution. Entities that emit CO₂ in the amount of no more than 500 tons per year are not taxpayers. In case of exceeding this amount, entities are obliged to register as taxpayers in the tax (reporting) period, prepare and submit tax reports, calculate and pay tax for the tax (reporting) period. For entities whose annual emissions exceed 500 tons, the tax base for the tax (reporting) year is reduced by the amount of such emissions in the amount of 500 tons per year.

Initially, the tax rate was only UAH 0.2 per 1 ton of emissions and gradually increased until 2018. In 2019, the tax rate was increased by more than 24 times - from UAH 0.41 per ton to UAH 10 per ton, and in 2022 - by another 3 times. As of 2024, the tax rate is 30 UAH/t. The tax rate is expected to increase further, but detailed plans for environmental tax reform (including the CO tax₂) are still being developed.

The Ministry of Ecology and the Ministry of Finance are developing a reform of the carbon dioxide tax. In particular, the National Revenue Strategy until 2030¹⁶⁹ , approved by the Government at the end of December 2023, stipulates that in 2024-2025, a model for the transition from taxation of actual carbon dioxide emissions to taxation of fossil fuel production (imports) (oil, gas, coal, etc.) depending on the carbon dioxide content should be developed, and a schedule for the implementation of changes to environmental and tax legislation should be determined. Other characteristics of this instrument (described above) remain unchanged.

The Tax Code stipulates that at least 70% of the revenues from the CO₂ emissions tax shall be directed to measures leading to the reduction of carbon dioxide emissions (decarbonization) by industries classified in Section C "Processing Industry" and Section D "Supply of Electricity, Gas, Steam and Air Conditioning" of the National Classifier of Ukraine "Classification of Economic Activities" [DK 009:2010](#), in accordance

¹⁶⁸ <https://zakon.rada.gov.ua/laws/show/2755-17/ed20230903#Text>

¹⁶⁹ https://www.mof.gov.ua/storage/files/National%20Revenue%20Strategy_2030_.pdf

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 Efficient Transformation from January 1, 2024 and revenues from the emissions tax. The Budget Code stipulates that at least 70% of revenues from the payment of the CO₂ emissions tax are defined as one of the sources of its filling (see more details in Section 3.2, PM_EE_WEM_02).

With the increase in the tax rate, tax revenues to the state budget have gradually increased. Thus, in 2021, the tax brought UAH 1.2 billion to the state budget¹⁷⁰. Although the tax rate has been increased 3 times since 2022, tax revenues increased by only 25% to UAH 1.5 billion, due to a significant decline in industrial production due to the full-scale invasion of Ukraine by the Russian Federation.

PM_D_WAM_01 National Plan for Reducing Emissions from Large Combustion Plants

Target: Gradual reduction of emissions (in million tons) of sulphur dioxide, nitrogen oxides and substances in the form of suspended particulate matter, undifferentiated by composition, from existing large combustion plants with a rated heat output of 50 MW or more and the first emission permit or permit for the design of the plant was issued before July 1, 1992; ensuring the implementation of Directive 2010/75/EU on industrial emissions.

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

Timeline: since 2017

Responsible authorities/organizations: Ministry of Energy

Description: The government approved the National Emission Reduction Plan for Large Combustion Plants (hereinafter referred to as the NERP)¹⁷¹ on November 8, 2017 in order to fulfill Ukraine's obligations under the Energy Community Treaty in terms of limiting pollutant emissions. The Ministry of Energy has been designated as the coordinator of the implementation of the National Plan.

Although the NERP is directly aimed at reducing atmospheric pollution rather than GHG emissions, the implementation of the NERP will indirectly contribute to the reduction of GHG emissions by reducing the operation of thermal generation facilities. Thus, Annex 4 to the NERP contains a list of facilities that should be closed after a certain limit of operating hours. In addition, all other installations from Annex 2 to the National Plan that have not been environmentally modernized in accordance with the requirements of Directive 2010/75/EU on industrial emissions are subject to decommissioning. In addition, sulphur dioxide and nitrogen oxides are GHG precursors, i.e., they contribute to the formation of GHGs under the influence of certain factors. Accordingly, the reduction of sulfur dioxide and nitrogen oxides emissions will have an additional positive impact on GHG emissions reduction.

In 2024-25, the government plans to develop a regulatory act defining the procedure and sources of funding for environmental measures under the NERP, as well as approving schedules for the reconstruction and closure of power units (subject to revision depending on the consequences of the war).

PM_D_WAM_02 National Greenhouse Gas Emissions Trading System

¹⁷⁰ <https://openbudget.gov.ua/national-budget/incomes>

¹⁷¹ <https://zakon.rada.gov.ua/laws/show/796-2017-%D1%80#Text>

Objective: To stimulate the reduction of greenhouse gas emissions (in million tons of CO₂-eq.).

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

Timeframe: from 2026

Responsible authorities/organizations: Ministry of Environmental Protection and Natural Resources

Description: Ukraine committed itself to implementing Directive 2003/87/EC establishing a scheme for trading in greenhouse gas emissions within the Community 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 the establishment of a national GHG emissions trading system (hereinafter referred to as the ETS) was the adoption of the Law "On the Principles of Monitoring, Reporting and Verification of Greenhouse Gas Emissions"¹⁷² (hereinafter referred to as the MRV) in 2019 and the bylaws that allowed the MRV system to be fully launched in 2021. Before the full-scale invasion of Ukraine by the Russian Federation, there were more than a thousand facilities that should have been covered by the MRV. According to preliminary estimates by the Ministry of Environment, the number of such facilities decreased by 40% due to the destruction of industrial facilities in Donbas and other regions of Ukraine by the Russian invaders. However, the registration of facilities in the IED system continues even during the full-scale invasion of Ukraine by the Russian Federation.

The draft Law of Ukraine "On the Greenhouse Gas Emissions Trading System" and the regulations necessary for the introduction of a domestic greenhouse gas emissions trading scheme in Ukraine should be developed in 2023-2024. The Ministry of Environment expects that the ETS can be launched in 2026 in a test mode.

PM_D_WAM_03 Action Plan for the implementation of Ukraine's climate policy within the framework of participation in the Global Methane Pledge initiative to reduce methane emissions

Objective: To stimulate the reduction of methane emissions (in million tons).

Legal basis: Order of the Cabinet of Ministers No. 607-r "On Approval of the Action Plan for the Implementation of the Climate Policy of Ukraine within the Framework of Participation in the Global Methane Pledge Initiative"

Timeframe: 2023-2030

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

Description: To fulfill Ukraine's commitments under the Global Methane Pledge, a global initiative to reduce methane emissions, the Government developed and approved an Action Plan on July 7, 2023¹⁷³. The plan envisages the implementation of 23 measures by 2030 in the sectors of natural gas and oil production, processing and transportation, coal mining, waste management, and agriculture. As an example, some of the most significant measures in the oil and gas sector are presented in Table 3.1 below.

¹⁷² <https://zakon.rada.gov.ua/laws/show/377-20#Text>

¹⁷³ <https://zakon.rada.gov.ua/laws/show/607-2023-%D1%80#Text>

implementation of the plan is expected to reduce methane emissions by 30% by 2030 from the 2020 emissions level.

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

Name of the event	Responsible implementation	Term of implementation, years	Sources of funding
Complete tracking of methane leaks during the production, processing and transportation of natural gas and oil	Ministry of Energy Ministry of Environment NJSC Naftogaz of Ukraine (by agreement) LLC GTS Operator of Ukraine (by agreement)	2023-2024	loans from international financial organizations; other sources of financing not prohibited by law
Implementation of effective accounting of methane leakage at energy sector enterprises in accordance with the OGMP 2.0 initiative	Ministry of Energy Ministry of Environment NJSC Naftogaz of Ukraine (by agreement) LLC GTS Operator of Ukraine (by agreement)	2023-2030	loans from international financial organizations; other sources of financing not prohibited by law
Develop and approve a sectoral action plan to reduce methane leakage and include such measures in investment programs at state-owned oil and gas enterprises	Ministry of Energy Ministry of Environment NJSC Naftogaz of Ukraine (by agreement) LLC GTS Operator of Ukraine (by agreement)	2023-2030	Loans from international financial organizations, including as part of the financing of post-war reconstruction and development of Ukraine; other sources of financing not prohibited by law
Development and approval of requirements for the gas transmission system operator and gas distribution system operators on regular practices for detecting and eliminating leaks from gas networks (LDAR)	Ministry of Energy NEURC (by agreement) LLC GTS Operator of Ukraine (by agreement) NJSC Naftogaz of Ukraine (by agreement)	2023	loans from international financial organizations; other sources of financing not prohibited by law

Policies and measures to reduce GHG emissions in the transportation sector

To stimulate the reduction of GHG emissions in the transport sector, a number of measures are envisaged to develop the use of RES 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 its action plan.

Policies and measures to reduce GHG emissions in the LULUCF sector

In the forestry sector, it is planned to take measures to restore forests damaged and destroyed as a result of the armed aggression of the Russian Federation, to carry out reforestation to increase the forest area by 1 million hectares by 2030, to apply forestry methods close to nature, etc.

Policies and measures to reduce GHG emissions in the waste sector

To stimulate the reduction of GHG emissions in the waste sector, a number of policies and measures are envisaged by the Law on Waste Management, the draft National Waste Management Plan of Ukraine until 2033¹⁷⁴ and the draft Action Plan of the National Waste Management Plan of Ukraine until 2033¹⁷⁵, which are scheduled to be approved in 2024.

ii. If appropriate, regional cooperation in this area

The draft action plan for the implementation of the NDCs stipulates that in 2023-2024, the procedure for reviewing, approving and implementing projects aimed at reducing anthropogenic emissions or increasing greenhouse gas absorption should be developed to enable the conclusion of bilateral cooperation agreements by launching voluntary cooperation under Article 6 of the Paris Agreement.

iii. Without prejudice to the application of rules on state aid, including Union support and the use of Union funds, in this area at the national level, if applicable

Under the budget program KPKVK 2701530 "State support for measures aimed at reducing greenhouse gas emissions (increasing absorption), including insulation of social security institutions, development of international cooperation on climate change", the Ministry of Finance finances measures for thermal modernization of social sector buildings.

The Budget Code envisages the establishment of the State Fund for Decarbonization and Energy Efficient Transformation from January 1, 2024, and revenues from the CO2 tax are identified as one of the sources of its filling (see more details in Section 3.2, PM_EE_WEM_02).

3.1.2. Renewable energy

i. Policies and measures to ensure the national contribution to the Union's 2030 binding renewable energy target and to achieve the trajectories as referred to in point (a)(2) of Article 4, as well as 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 renewable energy sources

¹⁷⁴ <https://mepr.gov.ua/wp-content/uploads/2023/12/proyekt-Natsionalnyj-plan-upravlinnya-vidhodamy-23.11-002.docx>

¹⁷⁵ https://mepr.gov.ua/wp-content/uploads/2023/12/Dodatok-1.-Plan-zahodiv-NPUV_23.11-1.docx

Objective: to stimulate the development of the RES sector (share in the structure of total final energy consumption)

Legal basis: 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 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, the 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

Timeline: 2009-2029

Responsible authorities/organizations: Ministry of Energy, NEURC

Description: The main instrument to stimulate the development of the RES sector was the feed-in tariff, which was introduced in 2008 by the Law of Ukraine "On Amendments to Certain Laws of Ukraine on Establishing the Feed-in Tariff" of September 25, 2008, No. 601-VI¹⁷⁶. The incentive tariff was applied to producers of electricity 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 premium for the use of Ukrainian-made equipment. At the time of its introduction, the feed-in tariff was set at a very high level, but was subsequently reduced through legislative changes in several stages.

However, the lack of sustainable financing mechanisms (especially under the new electricity market model) for the rapid growth of the RES sector has led to the accumulation of huge debts to renewable energy investors already in 2020. To reduce the cost of supporting renewable energy, the Government initiated negotiations with renewable energy investors on a voluntary restructuring of feed-in tariffs with the mediation of the Energy Community Secretariat. On June 10, 2020, the key parties signed a Memorandum of Understanding on the settlement of problematic issues in the field of renewable energy in Ukraine. The provisions of the Memorandum are reflected in Law 810-IX¹⁷⁷, which provides for a reduction in the rates of benefits for wind and solar power plants by 7.5% and 15%, respectively, the introduction of liability for imbalances, debt repayment, etc.

On June 30, 2023, the Verkhovna Rada adopted the 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"¹⁷⁸, which, starting from January 1, 2024, narrows the feed-in tariff to private households only, provided that they have buildings and other capital structures within their boundaries and consume electricity by a private household. The state support for RES electricity producers in the form of a feed-in tariff will remain in effect until December 31, 2029.

In general, the feed-in tariff contributed to the rapid growth of electricity generation from RES, from 51.8 million kWh in 2009¹⁷⁹ to 11.4 billion kWh·h in 2021¹⁸⁰. As of the beginning of 2022, the installed capacity

¹⁷⁶ <https://zakon.rada.gov.ua/laws/show/601-17#Text>

¹⁷⁷ <https://zakon.rada.gov.ua/laws/show/810-20#Text>

¹⁷⁸ <https://zakon.rada.gov.ua/laws/show/3220-20#Text>

¹⁷⁹ Annual Report of the NEURC for 2014, https://www.nerc.gov.ua/data/filearch/Catalog3/Richnyi_zvit_2014.pdf.
¹⁸⁰

https://www.nerc.gov.ua/storage/app/sites/1/Docs/Byuletен_до_річного_звіту/Byuletен_до_річного_звіту_nkrek_p-2021.pdf

of RES facilities that received the feed-in tariff, excluding facilities located in the temporarily occupied territories, amounted to 9,656 MW, including:

- solar power plants of business entities (producers) - 6,381 MW;
- solar power plants of private households (consumers) - 1205 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 from RES

Objective: to stimulate the generation of heat from alternative sources (the share of alternative energy sources in the production of heat by heat supply facilities)

Legal basis: The Law of Ukraine "On Amendments to the Law of Ukraine "On Heat Supply" to Stimulate the Production of Heat Energy from Alternative Energy Sources" No. 1959-VIII of March 21, 2017

Timeline: since 2017

Responsible authorities/organizations: Ministry of Infrastructure, Ministry of Energy, State Agency on 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 of 21.03.2017¹⁸¹. The Law establishes an incentive tariff for heat energy from alternative sources at the level of 90% of the current tariff for heat energy from gas (and in case of its absence - at the level of the weighted average tariff for heat energy from gas by region).

The law was expected to stimulate the increase in heat production from alternative sources at the local level, as well as to save budgetary funds. However, the actual effectiveness of the introduced tariff incentives for heat generation from alternative sources was not realized.

PM_D_WEM_04 Tax incentives for the import of renewable energy equipment

Objective: Stimulating the development of RES by reducing the cost of imported equipment operating on RES (share in the structure of total final energy consumption)

Legal basis: The Tax Code of Ukraine dated 02.12.2010 No. 2755-VI, the Customs Code of Ukraine dated 13.03.2012 No. 4495-VI, the Resolution of the Cabinet of Ministers of Ukraine dated 30.03.2016 No. 293 "Issues of Importation of Energy Saving Materials, Equipment, Machinery and Component Parts into the Customs Territory of Ukraine under Japanese Technology Demonstration Projects"

¹⁸¹ <https://zakon.rada.gov.ua/laws/show/1959-19#Text>

Timeframe: since 2010

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

Description: The Tax Code of Ukraine¹⁸² provides for a number of tax benefits for businesses operating in the RES sector. In particular, Article 197.16 provides for exemption from value added tax on imports 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 the consumption of fuel and energy resources, 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 to 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, the operation of which ensures the economy and rational use of fuel and energy resources.

In addition, Article 282 (clauses 14 and 16) of the Customs Code¹⁸³ stipulates that the above equipment and machinery are exempt from customs duties when imported into or exported from the customs territory of Ukraine. However, the duty exemption applies only if these goods are used by the taxpayer for its own production and if identical goods with similar quality indicators are not produced in Ukraine.

The procedure for granting these privileges, as well as the list of materials, equipment, machinery and components for the import of which these privileges apply, is defined by the Resolution of the Cabinet of Ministers of Ukraine No. 293 of 30.03.2016 "Issues of Importation of Energy Saving Materials, Equipment, Machinery and Components under Japanese Technology Demonstration Projects into the Customs Territory of Ukraine"¹⁸⁴.

PM_D_WEM_05 Exemption from customs duty on agricultural equipment running on biofuels

Objective: to stimulate the production and consumption of biofuels (in million tons of oil equivalent)

Legal basis: Customs Code of Ukraine dated 13.03.2012 No. 4495-VI

Timeframe: since 2012

Responsible authorities/organizations: State Customs Service

Description: The Customs Code (Article 282(17)) provides for the exemption from customs duties when importing into the customs territory of Ukraine or exporting from its borders, technical and transport

¹⁸² <https://zakon.rada.gov.ua/laws/show/2755-17#Text>

¹⁸³ <https://zakon.rada.gov.ua/laws/show/4495-17#n2353>

¹⁸⁴ <https://zakon.rada.gov.ua/laws/show/293-2016-%D0%BF#n16>

vehicles, including self-propelled agricultural machinery running on biofuels and classified by the codes according to the UKTZED defined in Article 7 of the Law of Ukraine "On Alternative Fuels", if such goods are not produced in Ukraine. The procedure for the import of such equipment is determined by the Cabinet of Ministers, but the relevant Resolution No. 581¹⁸⁵ expired on 24.03.2023, and the new procedure has not yet been approved (as of February 2024).

PM_D_WEM_06 Exemption of bioethanol from excise tax

Objective: to stimulate the production and use of bioethanol (in million tons of oil equivalent)

Legal basis: The Tax Code of Ukraine dated 02.12.2010 No. 2755-VI

Timeline: since 2010

Responsible authorities/organizations: Ministry of Finance, State Tax Service

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

According to the Ministry of Finance, as a result of the application of this benefit, the state budget did not receive UAH 569 million in 2018¹⁸⁶. In subsequent years, no estimates of potential budget losses were made.

PM_D_WAM_4 Auction system for the allocation of support quotas for RES

Objective: To create a competitive framework to support renewable energy projects and balance the interests of society and electricity consumers and other market participants, while ensuring further development of renewable energy and reducing the burden on the price of electricity.

Legal basis: The Law of Ukraine "On Amendments to Certain Laws of Ukraine on Ensuring Competitive Conditions for Electricity Production from Alternative Energy Sources" No. 2712-VIII of April 25, 2019, the Law of Ukraine "On Amendments to Certain Laws of Ukraine on the Restoration and Green Transformation of the Energy System of Ukraine" No. 3220-IX of June 30, 2023

Timeline: expected implementation by 2030

Responsible authorities/organizations: Ministry of Energy, NEURC

¹⁸⁵ <https://zakon.rada.gov.ua/laws/show/581-2011-%D0%BF#Text>

¹⁸⁶ <https://www.eu4environment.org/app/uploads/2023/09/Review-of-Energy-Subsidies-in-the-Context-of-Energy-Sector-Reforms-Ukraine-prefinal.pdf>

Description: In order to increase competition in the renewable energy market, the Law of Ukraine No. 2712-VIII¹⁸⁷ introduced an auction mechanism for large renewable energy installations in 2019. According to the Law, wind and solar installations with an installed capacity of more than 5 MW and 1 MW, respectively, are required to participate in auctions for the distribution of support quotas, while small producers can participate voluntarily. Small household installations with a capacity of 50 kW or less are still eligible for feed-in tariffs until 2029.

In order to launch auctions for RES, the CMU also adopted Resolution No. 1175 of 27.12.2019 "On the introduction of competitive conditions for stimulating the production of electricity from alternative energy sources"¹⁸⁸, which approves the procedure for holding auctions and allocating quotas to support RES.

On June 30, 2023, the Verkhovna Rada adopted 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", which improved the model of auctions for the distribution of quotas for support to electricity producers from energy sources, in particular, the Law introduced the following changes:

- setting the support period to 12 years;
- introducing a model of contracts for difference (market premium mechanism) instead of a fixed tariff;
- simplifying the conditions for participation in auctions;
- holding auctions for the construction of renewable energy facilities together with energy storage facilities;
- determining certain hours of the day during which support may be provided based on the results of the auction;
- granting the Cabinet of Ministers of Ukraine the right to determine the share of the auction price to be fixed in euros, but not less than 50%;
- determining the load profiles of renewable energy facilities for which the right to support has been acquired through an auction.

The auction mechanism is expected to promote the development of RES on a competitive basis. However, as of the beginning of 2024, this tool has not yet been launched.

PM_D_WAM_5 Market-based feed-in premium mechanism for RES electricity producers

Objective: to ensure the development of renewable electricity on a competitive basis, integration of "green" generation into the power system and electricity market.

Legal basis: 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

¹⁸⁷ <https://zakon.rada.gov.ua/laws/show/2712-19#Text>

¹⁸⁸ <https://zakon.rada.gov.ua/laws/show/1175-2019-%D0%BF#Text>

Timeframe: from 2024

Responsible authorities/organizations: 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 on the Restoration and Green Transformation of the Energy System of Ukraine", which introduced a number of new market instruments to support RES electricity producers, including the Feed-in-Premium or Contracts for Difference mechanism.

The market premium mechanism is a system of incentives for the production of electricity from alternative energy sources, under which the guaranteed buyer pays to business entities that have been set a feed-in tariff and business entities that have acquired the right to support based on the results of the auction the difference between the feed-in tariff or auction price, including a premium to it, and the settlement price determined in accordance with the procedure established by the Law of Ukraine "On the Electricity Market".

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

PM_D_WAM_6 Direct power purchase agreements between electricity producers and end-users (corporate PPAs)

Objective: To stimulate the development of the RES sector on a market basis.

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

Timeframe: from 2024

Responsible authorities/organizations: Ministry of Energy, NEURC

Description: Law No. 3220-IX removed a number of regulatory obstacles to the conclusion of direct power purchase agreements between energy producers and end users (corporate PPAs), under which the buyer of electricity is a private consumer, not the state represented by a guaranteed buyer. In particular, the Law removed the obligation for renewable energy generators to sell electricity under bilateral agreements at electronic auctions, but retained the right to continue using this tool on a voluntary basis. The Law also expanded the list of counterparties for concluding a contract for the provision of services to ensure the stability of the price of electricity produced from alternative energy sources other than consumers to include electricity suppliers and traders. In addition, the NEURC's right to set the maximum term of bilateral agreements no longer applies to agreements concluded by renewable energy producers. These changes have created opportunities for businesses that produce electricity from RES or plan to become such producers to look for partners for long-term bilateral power purchase agreements at the project development stage.

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 electricity producers from alternative energy sources and consumers (Corporate PPA's), both physical and virtual.

PM_D_WAM_7 Guarantees of electricity origin from RES

Objective: to stimulate the development of renewable electricity on a competitive basis and to implement the provisions of European legislation, in particular, Directive 2018/2021 of the European Parliament and of the Council 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 the Energy System of Ukraine" of June 30, 2023

Timeline: from 2024

Responsible authorities/organizations: NEURC, Ministry of Energy

Description: At the end of June 2023, the Verkhovna Rada adopted Law of Ukraine No. 3220-IX, which introduced a mechanism for issuing, using and terminating guarantees of origin of electricity produced from renewable energy sources. The Law stipulates that guarantees of origin of electricity produced from renewable energy sources are an electronic document generated on the basis of information from the register of guarantees of origin of electricity produced from renewable energy sources, which confirms that a certain amount of electricity is produced from renewable energy sources, confirms its environmental value and certifies the rights related to the positive effect of electricity production from renewable energy sources. Guarantees of origin confirm the origin of electricity produced from renewable energy sources:

- a business entity that produces electricity from renewable energy sources,
- by a consumer who has installed a generating installation for their own consumption, or
- an active consumer.

The Guarantee of Origin is issued for 1 MWh of RES electricity supplied to the grid or produced and used for own consumption. The Guarantee of Origin is automatically generated in a special register and issued free of charge in accordance with the procedure for issuance, circulation and repayment approved by the Cabinet of Ministers of Ukraine. The NEURC is the body responsible for the issuance, circulation and redemption of guarantees of origin and ensures the functioning of the register of guarantees of origin.

The guarantee of origin of renewable electricity is valid for 12 months from the date of its production. At the same time, the holder of the guarantee of origin has the right to redeem it within 18 months from the date of production of the corresponding amount of electricity. The purchase and sale of guarantees of origin for electricity generated from renewable energy sources is carried out on a market basis at free prices. Export and import of guarantees of origin of electricity generated from renewable energy sources are carried out under foreign economic agreements (contracts). However, in order to realize export opportunities, it is necessary to ensure full compliance of the mechanism of guarantees of origin with European standards. To this end, the NEURC is tasked by the Law to ensure the integration of the register of guarantees of origin of electricity from renewable energy sources with the registers of the Energy Community, the European Union and the Organization for Economic Cooperation and Development.

To fully launch the mechanism for guaranteeing the origin of electricity from renewable sources, a number of bylaws are expected to be adopted in the coming months, including the procedure for issuing, circulating and redeeming guarantees of origin and the launch of the relevant register.

It is expected that the introduction of an effective system of guarantees for the origin of electricity from RES will be a significant impetus for the development of the RES sector in Ukraine and will create preconditions for the export of "green" electricity.

In addition, a number of instruments are currently being developed to stimulate the development of distributed generation of electricity from RES and are expected to be fully implemented in the near future, including support for active consumers through the self-generation mechanism (PM_IME_WEM_03) and the state targeted 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).

iii. Specific financial support measures, if applicable, including Union support and the use of Union funds, to stimulate the production and use of energy from RES in the electricity, heating and cooling and transport sectors

The cost of price support for RES electricity producers selling electricity at the feed-in tariff in 2020 reached UAH 39,033 million¹⁸⁹. In addition, a number of tax incentives are available to producers of electricity from RES, as well as biofuels (described above PM_D_WEM_04, PM_D_WEM_05, PM_D_WEM_06). However, the cost of such support (in the form of lost tax revenues to the state budget) for the RES sector has not been estimated in recent years.

v. Specific measures to establish one or more contact points, streamline administrative procedures, provide information and training, and facilitate the conclusion of power purchase agreements

Review of policies and measures in line with the framework for assistance to be adopted by Member States in accordance with Article 21(6) and Article 22(5) of Directive (EC) 2018/2001 to promote the development of domestic energy consumption and renewable energy communities

Two instruments are expected to be launched soon to promote the development of self-generated energy consumption: support for active consumers through the mechanism of self-production (PM_IME_WEM_03) and the state targeted 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 more details in Section 3.4.3.ii).

vii. If applicable, specific measures to stimulate the use of biomass energy, especially to mobilize new biomass, taking into account:

- availability of biomass, including sustainable biomass: both national potential and imports from third countries
- other applications of biomass in other sectors (agriculture and forestry), as well as measures to ensure the sustainability of biomass production and use

¹⁸⁹ <https://www.eu4environment.org/app/uploads/2023/09/Review-of-Energy-Subsidies-in-the-Context-of-Energy-Sector-Reforms-Ukraine-prefinal.pdf>

For producers of electricity and heat from biomass, most of the policies and measures described in section 3.1.2 above are available as for producers based on other renewable sources.

3.1.3. Other measurement elements

i. If applicable, national policies and measures affecting the EU ETS sector, as well as an assessment of complementarity and impact on the EU ETS

Not applicable.

ii. Policies and measures to achieve other national targets, if applicable

PM_D_WAM_8 State Target Program for the Equitable Transformation of Ukraine's Coal Regions for the Period up to 2030

Objective: To overcome the problems of socio-economic development of coal regions due to the closure of coal mining and related enterprises.

Legal basis: CMU Resolution No. 1024 of September 22, 2021 "On Approval of the Concept of the State Target Program for the Fair Transformation of Coal Regions of Ukraine for the Period up to 2030".

Timeline: 2025 - 2030

Responsible authorities/organizations: Ministry of Communities, Territories and Infrastructure Development of Ukraine, Ministry of Energy

Description: The EGD states that the **use of coal-fired generation will be reduced until its complete decommissioning in 2035**. In addition, the draft action plan for the implementation of the updated NER stipulates that as part of the gradual phase-out of coal use, unprofitable unpromising state-owned coal mining enterprises will be liquidated by 2030.

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 Target Program for the Fair Transformation of Ukraine's Coal Regions for the period up to 2030¹⁹⁰. According to the Concept, coal regions are defined as regions where coal mining and coal processing enterprises are located, including those that are in the process of liquidation, conservation or reorientation to other types of economic activity, and coal-fired thermal generation enterprises, regardless of ownership. In total, these are about 20 territorial communities in Volyn, Dnipro, Donetsk, Luhansk and Lviv regions with a population of about 850 thousand people.

The concept envisaged the development of a draft State Target Program for the Fair Transformation of Ukraine's Coal Regions for the period up to 2030 within six months. However, due to the full-scale invasion of Ukraine by the Russian Federation, the development of the state program was postponed due to the impossibility of assessing the condition of flooded mines in the temporarily occupied territories, as well as military operations and the continuous destruction of the infrastructure of Vuhledar and other settlements of coal communities in Donetsk Oblast.

¹⁹⁰ <https://zakon.rada.gov.ua/laws/show/1024-2021-%D0%BF#Text>

In addition, the Government plans to establish the Fair Transformation Fund for Coal Regions as an effective and transparent mechanism for financing transformation projects in coal regions.

PM_D_WAM_9 Strategy of environmental safety and adaptation to climate change for the period up to 2030

Objective: To improve environmental safety, reduce the impacts and consequences of climate change in Ukraine.

Legal basis: Order of the Cabinet of Ministers "On Approval of the Strategy for Environmental Security and Climate Change Adaptation for the Period up to 2030" No. 1363-r of October 20, 2021.

Timeline: 2021 - 2030

Responsible authorities/organizations: Ministry of Environmental Protection and Natural Resources

Description: To achieve the goal of **strengthening the adaptive capacity and resilience of social, economic and environmental systems to climate change**, the Strategy for Environmental Security and Adaptation to Climate Change for the period up to 2030¹⁹¹ defines a number of tasks, in particular:

- conducting sectoral research on risk assessment, vulnerability and climate change forecasting in the areas of water management, biodiversity conservation, forestry, energy, public health, agriculture and soil, transport and infrastructure, and tourism;
- development of climate change adaptation action plans in the areas of water management (as part of the river basin management plan), biodiversity conservation, forestry, energy, public health, agriculture and soil, transport and infrastructure, and tourism;
- Ensuring that current and projected climate change impacts are taken into account in strategic planning at the national, regional and local levels, as well as in the construction of infrastructure;
- revising state building codes to take into account the current and projected effects of climate change;
- Strengthening the resilience of forest ecosystems to pests and new climate conditions, implementing measures to prevent and respond quickly to fires;
- technical upgrades and development of hydrometeorological observation and forecasting systems;
- conducting a financial assessment of the implementation of climate change adaptation measures.

The Strategy will be implemented through the implementation of measures defined in the operational implementation plans, which will be approved by the orders of the Cabinet of Ministers of Ukraine for a three-year period, as well as the National Environmental Action Plan for the period up to 2025, approved by the Order of the Cabinet of Ministers of Ukraine No. 443 of April 21, 2021¹⁹².

Thus, the operational plan for the implementation of the Strategy in 2022-2024 envisages the implementation of 28 measures, including the preparation of studies and recommendations for the

¹⁹¹ <https://zakon.rada.gov.ua/laws/show/1363-2021-%D1%80#Text>

¹⁹² <https://zakon.rada.gov.ua/laws/show/443-2021-%D1%80#n12>

integration of adaptation issues into strategic documents at the local and national levels, the assessment of risks and vulnerability to climate change in various socio-economic sectors and the development of sectoral adaptation action plans, the development of regional and local climate change adaptation strategies or the inclusion of climate change adaptation issues in regional development strategies, and the

Implementation of the Strategy should ensure the achievement of the goal and strategic objectives, in particular, to strengthen 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 vehicles

Objective: To stimulate the production and use of electric vehicles.

Legal basis: Tax Code of Ukraine dated 02.12.2010 No. 2755-VI, Customs Code of Ukraine dated 13.03.2012 No. 4495-VI, Law of Ukraine dated 26.06.1997 No. 400/97-BP "On the Compulsory State Pension Insurance Duty"¹⁹³, Law of Ukraine dated 4.06.2020 No. 674-IX "On the Customs Tariff of Ukraine"¹⁹⁴

Timeframe: since 2018

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

Description: The Tax and Customs Codes of Ukraine provide for a number of tax incentives to encourage the use of electric cars, which were introduced in 2018 and extended several times. In particular, no duty is levied on the import of electric vehicles (Section XVII of the Customs Tariff of Ukraine), and import operations into the customs territory are exempt from VAT (clause 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 ICE or hybrid vehicles - EUR 1 per 1 kWh of electric battery capacity (Article 215.3.).

Starting from July 1, 2022, passenger electric cars will also be exempt from paying the mandatory state pension insurance fee upon first registration (clause 7 of Article 1 of the Law of Ukraine "On the Mandatory State Pension Insurance Fee").

To stimulate the domestic production of electric vehicles, from 1 January 2022 to 1 January 2031, operations on the importation of goods used for the domestic production of vehicles equipped with electric motors exempt from import duty (subparagraph 16 of paragraph 4 of Section XXI of the Customs Code) and VAT (paragraph 78 of subsection 2 of Section XX of the Tax Code).

In addition, from January 1, 2022 to December 31, 2035, the profits of enterprises engaged exclusively in the production of electric motors, as well as manufacturers of lithium-ion (lithium-polymer) batteries and chargers intended for vehicles equipped exclusively with electric motors, as well as manufacturers of vehicles equipped exclusively with electric motors, are exempt from taxation (paragraph 56 of Subsection 4 of Section XX of the Tax Code). In this case, the released funds (tax amounts that are not paid to the budget and remain at the disposal of the taxpayer) should be used for research and development work in the field of electric transport, creation or re-equipment of the material and technical base, increase in

¹⁹³ <https://zakon.rada.gov.ua/laws/show/400/97-%D0%B2%D1%80/ed20231208#Text>

¹⁹⁴ <https://zakon.rada.gov.ua/laws/show/674-20#Text>

production, and introduction of the latest technologies. The procedure for controlling the use of the released funds is established by the Cabinet of Ministers of Ukraine.

According to the Ministry of Finance¹⁹⁵, the expected amount of budget losses in 2022 due to the tax privileges is as follows:

- in connection with the VAT exemption for the supply of vehicles equipped exclusively with electric motors in the customs territory of Ukraine - about UAH 364 million;
- in connection with the exemption from taxation of profits of enterprises engaged exclusively in the production of electric motors intended for vehicles equipped exclusively with electric motors and electric vehicles - UAH 584 million.

The effectiveness of these tax incentives has not been specifically evaluated. However, the number of cars with exclusively electric motors increased from 7,439 units in 2018 (as of May 1)¹⁹⁶ to 72,435 units in 2023 (as of September)¹⁹⁷, i.e., almost tenfold, which may indirectly indicate 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: Reduce the consumption of fossil fuels and energy resources by the transport sector

Legal basis: The Law of Ukraine No. 2956-IX "On Certain Issues of the Use of Vehicles Equipped with Electric Engines and Amendments to Certain Laws of Ukraine on Overcoming Fuel Dependence and Development of Electric Charging Infrastructure and Electric Vehicles"

Timeframe: from 2023.

Responsible authorities/organizations: Ministry of Infrastructure

Description: In March 2023, the Law of Ukraine "On Certain Issues of the Use of Vehicles Equipped with Electric Engines and Amendments to Certain Laws of Ukraine on Overcoming Fuel Dependence and Development of Electric Charging Infrastructure and Electric Vehicles" (the "Electric Transport Law") came into force. According to this Law, ensuring the development of electric vehicles and the infrastructure of electric vehicle charging stations is a priority in the formation of state policy in the field of road transport. The term "electric vehicle" includes both passenger and freight vehicles equipped exclusively with electric motors (one or more) and an electric energy storage system.

In accordance with the current building codes, at least 5% of the total number of parking spaces in parking lots and parking garages must be provided for the parking of electric vehicles. Such spaces can be equipped with charging stations¹⁹⁸.

Pursuant to Law No. 2956-IX, state authorities and local governments must approve programs for the development of electric charging infrastructure by 31 December 2023, which will provide for the provision of state-owned or municipally owned facilities with electric vehicle charging stations at existing parking lots, garages and other parking areas (except for those used exclusively by such authorities or state or

¹⁹⁵ <https://itd.rada.gov.ua/billInfo/Bills/pubFile/1473870>

¹⁹⁶ https://texty.org.ua/fragments/85448/Skilky_de_ta_jakyh_jelekromobiliv_v_Ukrajini-85448/

¹⁹⁷ <https://eauto.org.ua/news/393-rekordna-kilkist-vzhivanih-elekromobiliv-z-za-kordonu-ta-import-novih-z-kitayu-shcho-kupuvali-u-veresni>

¹⁹⁸ DBN V.2.3-15:2007. Parking lots and garages for passenger cars. https://e-construction.gov.ua/laws_detail/284578636808847244?doc_type=2

municipal enterprises, institutions, organizations) in accordance with building codes. In accordance with such programs, state and municipal commercial enterprises and public sector entities must, by December 31, 2024, provide existing facilities owned by such entities or assigned to them on the right of economic management with the necessary contractual capacity and electric vehicle charging stations in existing parking lots, garages and other parking spaces (except for those used exclusively by such entities).

The Law on Electric Transport stipulates that projects for the new construction of multi-storey residential buildings must take into account the need to provide at least 50% of the parking spaces for electric vehicles with charging stations. The Law also provides for the development of electric charging infrastructure for existing buildings: condominium associations have the right to set up charging stations on the adjacent territory and independently determine the procedure for using and paying for such stations.

PM_D_WEM_09 Stimulating the development of low-carbon municipal transport

Objective: Reduce the consumption of fossil fuels and energy resources by the transport sector

Legal basis: The Law of Ukraine No. 2956-IX "On Certain Issues of the Use of Vehicles Equipped with Electric Engines and Amendments to Certain Laws of Ukraine on Overcoming Fuel Dependence and Development of Electric Charging Infrastructure and Electric Vehicles"

Timeframe: 2023-2036.

Responsible authorities/organizations: Ministry of Communities, Territories and Infrastructure Development of Ukraine

Description: The Law on Electric Transport provides for the gradual replacement of municipal transport with low-carbon alternatives. **On city bus routes in cities with a total population of more than 250 thousand people, the number of electric buses and/or buses running exclusively on methane (compressed or liquefied) or biogas and/or hydrogen fuel cell buses as a percentage of the bus fleet must be at least:**

- 25% as of January 1, 2030;
- 50% as of January 1, 2033.

In addition, starting from January 1, 2036, only electric buses or buses running exclusively on methane (compressed or liquefied) or biogas and/or buses with a hydrogen fuel cell (cell) are allowed to transport passengers **on public bus routes in the mode of regular passenger transportation in cities of district and regional significance.**

At the same time, local governments have the opportunity to revise these shares (but not more than 50%) and terms (not more than two years).

Starting from January 1, 2028, gradual restrictions will be imposed on the purchase of buses with internal combustion engines for use in public transport.

3.2. Dimension "Energy efficiency"

Planned policies, measures and programs to achieve the indicative national energy efficiency contributions for 2030 and the other targets referred to in Article 2.2, including planned measures and instruments (including financial instruments) to improve the energy performance of buildings, in particular those related to the elements listed below:

i. Energy efficiency obligation schemes and alternative policy measures in accordance with Articles 7a and 7b and Article 20(6) of Directive 2012/27/EU, to be developed in accordance with Annex III to this Regulation

As of the end of 2022, the cumulative value of the achieved energy savings amounted to 36.97 GWh, the cumulative value of the reduction of CO emissions₂ - 10,360 thousand tons. When assessing the achievement of the annual energy consumption reduction target, the calculation may include energy savings achieved as a result of energy efficiency measures implemented since December 31, 2008, which affect the reduction of energy consumption after the entry into force of the Law on Energy Efficiency and can be measured and evaluated.

The Law of Ukraine "On Energy Efficiency" provides for an alternative approach to the implementation of Article 7 of Directive 2012/27/EU. The target annual energy consumption reduction is achieved in the following ways:

- the activities of the Energy Efficiency Fund and other funds;
- implementation of state targeted 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 in accordance with the acts of the European Union legislation and decisions of the Energy Community;
- introducing requirements for energy labeling and eco-design of energy-consuming products for which no requirements are established in accordance with the norms of the EU legislation and decisions of the Energy Community;
- implementing other measures that result in an annual reduction in energy consumption.

The following instruments are available or planned to implement this policy: PM_EE_WEM_01 Activities of the Energy Efficiency Fund; PM_EE_WEM_02 State Fund for Decarbonization and Energy Efficient Transformation; PM_EE_WAM_01 Energy Efficiency Obligation Scheme; PM_EE_WAM_02 Implementation of the State Targeted Economic Program for Supporting Thermal Modernization of Buildings until 2030; PM_EE_WAM_10 Implementation of the State Target Economic Program for Energy Modernization of Heat Producing Enterprises in State or Municipal Ownership for the Period up to 2030.

PM_EE_WEM_01 Activities of the Energy Efficiency Fund

Objective: To support energy efficiency initiatives, introduce instruments to stimulate and support the implementation of measures to improve the energy efficiency of buildings and energy saving, in particular in the residential sector

Legal basis: The Law of Ukraine "On the Energy Efficiency Fund".

Timeframe: 2018 - indefinitely.

Responsible authorities/organizations: Energy Efficiency Fund, Ministry of Infrastructure.

Description:

a) Energodom program

The Fund provides partial reimbursement for energy efficiency measures under the Energodom Fund Program.

According to the law "On the Energy Efficiency Fund," the Fund provides grants exclusively to condominium associations.

The establishment of condominiums is not mandatory in Ukraine. According to the State Statistics Service, as of January 1, 2024, 39,709 HOAs were registered¹⁹⁹ with a total number of about 180 thousand apartment buildings. Pursuant to the Law of Ukraine "On Amendments to Certain Laws of Ukraine on Simplification of Management of Apartment Buildings" (3270-IX of 14.07.2023), which entered into force in November 2023, as a general rule, a decision of a condominium is adopted if it is voted for by co-owners who together have more than half of the total number of votes of all co-owners. The HOA may increase the required number of votes (up to 67 percent of the total number of votes of all co-owners) to make decisions on the following issues: election of governing bodies of the association, change of the form of governance, setting and changing the amount of contributions/payments, approval of the budget. Co-owners can vote at the association's meeting or in writing, including the possibility to sign survey sheets with a list of decisions made with an electronic digital signature.

Beneficiaries of the Fund can choose one of two packages of energy efficiency measures to implement in their homes, Light or Comprehensive.

The "Light" package (Package A) includes the following mandatory measures:

- installation of a house heat meter;
- installation or modernization of an individual heating point (IHP).

Additionally, condominiums can receive partial reimbursement for the cost of implementing additional measures defined by the Energodom Program.

The "comprehensive" package (Package B) includes the following mandatory measures:

- mandatory measures for Package A;
- Thermal insulation and/or replacement of pipelines of the internal heating system and hot water supply system in unheated premises;
- installation of automatic (balancing) valves;
- replacement or repair of external doors and/or arrangement of external entrance vestibules; replacement or repair of windows in common areas of the building.

Similarly to Package A, HOAs have the opportunity to receive a grant to implement additional (optional) measures defined by the Program.

The amount of partial reimbursement of the cost of energy efficiency measures (grant) varies depending on the time of application (increased grant amount for the first 500 applications) and the selected package of measures. The current grant amounts are:

- 70% of the cost of conducting a preliminary energy audit; development of project documentation and its examination; technical and author's supervision services; certification of energy efficiency after the project implementation and inspection of building engineering systems where energy efficiency measures were implemented during the 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.

The government plans to gradually reduce the share of reimbursement for energy efficiency measures after the termination/liquidation of martial law²⁰⁰.

Grants are provided by the Energy Efficiency Fund in separate tranches, after the relevant stage of the project has been implemented and verified by the Fund. HOAs can receive partial advance payment for

¹⁹⁹ https://www.ukrstat.gov.ua/edrpoy/ukr/EDRPU_2024/ks_opfg/ks_opfg_s_0124_ue.xls

²⁰⁰ Operational Action Plan for the implementation in 2024-2026 of the Long-Term Strategy for Thermal Modernization of Buildings for the period up to 2050, approved by the Cabinet of Ministers of Ukraine No. 1228 of 29.12.2023: <https://zakon.rada.gov.ua/laws/show/1228-2023-%D1%80#Text>

construction works, provided that the contractors selected by the HOAs meet the Fund's requirements set out in the Energodom Program.

Results: As of December 15, 2023, construction works on 316 projects of the Fund were fully or partially completed. The total value of energy savings achieved is 315.2 million kWh/year, the total value of CO2 emission reductions is 84.8 thousand tons/year²⁰¹.

Achieving an annual increase in energy efficiency of energy consumption through the activities of the Energy Efficiency Fund largely depends on sustainable state funding. At the same time, expenditures for the Energy Efficiency Fund were not envisaged in the State Budget for 2020, 2023-2024.

In 2018-2026, the Energy Efficiency Fund plans to implement more than 800 projects and expects another 300 projects to be underway. The expected reduction in CO2 emissions is more than 120 thousand tons per year²⁰².

Planned activities: The Government also plans to expand the scope of the Energy Efficiency Fund by allocating funding to:

- 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 (manor) houses.

The relevant changes to the Energy Efficiency Fund Program will be made in the fourth quarter of 2024.²⁰³

The ESA, among the measures in the area of "Reducing Energy Poverty" by 2025, envisages studying the feasibility of introducing subsidies for small energy renovations for vulnerable households on a first-come, first-served basis, with priority given to vulnerable consumers. Such an analysis should be carried out as part of the assessment of options for expanding the financing of the Energy Efficiency Fund's Energodom Program. According to the ESA, the implementation of energy efficiency measures will be stimulated by subsidizing vulnerable consumers, providing grants and low-interest loans for a certain group of households (those with low incomes) until 2032.

Currently, the Fund is focusing on implementing single projects, but in the second quarter of 2024, a pilot project for the thermal modernization of a residential area (the Energy Efficient District of Lviv project), implemented by the Energy Efficiency Fund with the support of GIZ, is expected to be completed. This approach will help operationalize the principle of "energy efficiency first" and ensure comprehensive synergistic thermal modernization of buildings, heating networks and heat-generating equipment.

6) Restore program

In August 2022, the Law of Ukraine "On the Energy Efficiency Fund" was amended to allow the Fund to finance not only energy efficiency measures, but also programs related to the restoration of buildings destroyed and/or damaged as a result of armed aggression. In November 2022, a new program of the Fund - Restore - was launched. This Program is also limited to condominiums. Funding under the Restore Program is provided for the following types of work (services):

- replacement or repair of damaged windows, external and internal vestibule doors;
- repairing damage to the building's facades;
- repair of damages to the roof/roof structures of the building;

²⁰¹ <https://eefund.org.ua/wp-content/uploads/2024/01/strategiya-fondu-energoefektyvnosti-2024-2026-povnaversiya-1.pdf>

²⁰²<https://eefund.org.ua/wp-content/uploads/2024/01/strategiya-fondu-energoefektyvnosti-2024-2026-povnaversiya-1.pdf>

²⁰³ Operational Action Plan for the implementation in 2024-2026 of the Long-Term Strategy for Thermal Modernization of Buildings for the period up to 2050, approved by the Cabinet of Ministers of Ukraine No. 1228 of 29.12.2023: <https://zakon.rada.gov.ua/laws/show/1228-2023-%D1%80#Text>

- repair of damaged equipment of roof boilers and utility networks.

Funding is provided for construction works, as well as for the purchase of materials and equipment necessary for the performance of such works. Such financing is provided in the form of a grant in the amount of 100% of the cost of eligible project activities, but not more than UAH 7.2 million.

Results: As of December 15, 2023, construction works on 211 projects of the Fund have been fully or partially completed²⁰⁴.

PM_EE_WEM_02 State Fund for Decarbonization and Energy Efficient Transformation

Objective: Co-financing of projects (activities) that lead to the reduction of CO2 emissions.

Legal basis: The Budget Code of Ukraine.

Timeline: 2023 - indefinitely.

Responsible authorities/organizations: Ministry of Infrastructure, Ministry of Finance, State Agency on Energy Efficiency and Energy Saving.

Description: In May 2023, amendments to the Budget Code of Ukraine came into force, which established the State Fund for Decarbonization and Energy Efficient Transformation (Decarbonization Fund) as a separate budget program within a special fund of the State Budget of Ukraine. The funds of the Decarbonization Fund will be used to:

- financing measures and state targeted programs in the field of energy efficiency, increasing the use of renewable energy sources and alternative fuels, and reducing CO2 emissions;
- financing compensation, reimbursement, and reduction of liabilities of individuals and legal entities under loan and leasing agreements concluded to implement energy efficiency measures, introduce energy services, increase the use of renewable energy sources and alternative fuels, and reduce CO2 emissions;
- fulfillment of debt obligations on borrowings received by the state for the implementation of investment projects in the field of energy efficiency, increased use of renewable energy sources and alternative fuels, and reduction of CO2 emissions.

The Decarbonization Fund will be replenished by deductions from the CO2 emission tax (part of the environmental tax), government borrowings, and other revenues. The state budget for 2024 provides for the financing of the Decarbonization Fund in the amount of UAH 759.2 million. The mechanism for providing funds from the Decarbonization Fund and details of possible financing measures should be regulated by the Procedure for the use of the State Fund for Decarbonization and Energy Efficiency Transformation, which is to be approved by the Cabinet of Ministers of Ukraine.

The energy savings achieved as a result of the implementation of measures financed by the Decarbonization Fund may be taken into account when determining the achieved total amount of energy saved in end-use only if a monitoring and verification system is implemented that meets the requirements of Directive 2012/27/EU.

Results: Planned policy.

PM_EE_WAM_01 Energy Efficiency Commitment Scheme

Objective: Implementation of energy efficiency measures on market conditions.

²⁰⁴[https://eefund.org.ua/wp-content/uploads/2024/01/strategiya-fondu-energoefektyvnosti-2024-2026-povnaversiya-1.pdf](https://eefund.org.ua/wp-content/uploads/2024/01/strategiya-fondu-energoefektyvnosti-2024-2026-povnoversiya-1.pdf)

Legal basis: The Law of Ukraine "On Energy Efficiency".

Timeframe: Within the period determined by the Cabinet of Ministers of Ukraine.

Responsible authorities/organizations: Ministry of Infrastructure, State Agency on Energy Efficiency and Energy Saving.

Description: In case of failure to achieve the target annual energy consumption reduction through organizational, economic and legal measures to stimulate energy efficiency, activities of the Energy Efficiency Fund, and other mechanisms, the Cabinet of Ministers of Ukraine has the opportunity to activate the energy efficiency obligation scheme. The Law of Ukraine "On Energy Efficiency" defines electricity and natural gas suppliers as obligated parties. Obligated parties can ensure compliance with the scheme's requirements by:

- independent implementation of acceptable energy efficiency measures at the level of end-users;
- engaging energy service providers and other business entities to implement energy efficiency measures;
- payment of a contribution to the Energy Efficiency Fund.

The lists of eligible measures under the energy efficiency obligation scheme, the definition of targets for achieving energy consumption reductions for individual obligated parties, and the procedure for monitoring the achieved energy consumption reductions will be regulated by secondary legislation.

Subject to the implementation of an appropriate system of monitoring and verification of the achieved energy savings, measures aimed at achieving the target indicator of the total amount of energy saved in end use may also be recognized as **PM_EE_WAM_02 Implementation of the State Target Economic Program for Support of Thermal Modernization of Buildings until 2030** and **PM_EE_WAM_10 Implementation of the State Target Economic Program for Energy Modernization of Enterprises - Heat Producers in State or Communal Ownership for the period up to 203**

ii. A long-term renovation strategy to support the renovation of the national stock of residential and nonresidential buildings in public and private ownership, including policies, measures and actions to stimulate cost-effective in-depth renovation targeting 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 Targeted Economic Program to Support Thermal Modernization of Buildings until 2030

Objective: Implementation of long-term goals in the field of improving the energy efficiency of buildings.

Legal basis: The Law of Ukraine "On Energy Efficiency of Buildings"; the draft Long-Term Strategy for Thermal Modernization of Buildings until 2050; the draft Concept of the State Targeted Economic Program for Support of Thermal Modernization of Buildings until 2030.

Timeframe: 2024-2030.

Responsible authorities/organizations: Ministry of Infrastructure; State Agency on Energy Efficiency and Energy Saving.

Description: In order to ensure the achievement of the goals of the first stage of the Long-Term Strategy for Thermal Modernization of Buildings until 2050, the Cabinet of Ministers of Ukraine approved the Concept of the State Targeted Economic Program for Supporting Thermal Modernization of Buildings until

2030 (Concept of the Program for Supporting Thermal Modernization of Buildings) by the Order of the Cabinet of Ministers of Ukraine No. 1228 of December 29, 2023.²⁰⁵

The concept of the program to support the thermal modernization of buildings envisages the implementation of the following measures to stimulate energy efficiency in the **residential sector**:

- reimbursement of a part of the loan amount to citizens for the implementation of priority energy efficiency measures or thermal modernization in individual residential buildings;
- providing support to citizens who own individual houses destroyed as a result of hostilities for the construction of residential buildings with close to zero energy consumption;
- encouraging citizens to install heat pumps in individual heating systems of apartment buildings that are not connected to district heating systems;
- Encouraging citizens to install mechanical ventilation systems with heat energy recovery in multi-apartment and individual residential buildings;
- incentivizing local governments to reconstruct (modernize) or overhaul heating and hot water systems in apartment buildings connected to the district heating system;
- Encouraging local governments to ensure the installation of heat metering units (including heat distributors) together with automatic air temperature controllers in apartment buildings.

In the **sector of state-owned and municipal buildings**, the Concept of the program to support thermal modernization of buildings provides for:

- Implementation of priority energy efficiency measures or thermal modernization projects;
- Ensuring the construction (including the reconstruction of public buildings damaged as a result of hostilities) of state-owned buildings housing public authorities, with the requirements for buildings with close to zero energy consumption;
- Ensuring the implementation of energy management systems in central executive authorities and local state administrations;
- encouraging local governments to implement energy management systems;
- Encouraging local governments to install mechanical ventilation systems with heat recovery in public buildings of communal ownership, in particular, aimed at counteracting the spread of the acute respiratory disease COVID-19 caused by the coronavirus SARS-CoV-2 and other diseases.

Among other things, the Concept of the Program to Support Thermal Modernization of Buildings identifies the need to **create a favorable market environment** for thermal modernization of buildings and development of energy services. The Program Concept envisages the following measures to support businesses:

- promoting the development of micro and small businesses that carry out or plan to carry out economic activities in the field of thermal modernization of buildings, including by providing partial state guarantees and reimbursement of part of the interest on loans taken out by them for thermal modernization of buildings;
- promoting the development of energy-efficient equipment (heat pumps, air recuperators, automatic control devices, etc.) and energy-saving construction products (thermal insulation systems, highly efficient window structures, etc.) in Ukraine;

²⁰⁵ <https://zakon.rada.gov.ua/laws/show/1228-2023-%D1%80#Text>

- reimbursement of part of the interest on loans taken by energy service providers for comprehensive thermal modernization of state-owned and municipal buildings;
- ensuring the functioning of factoring for energy service contracts for the thermal modernization of state-owned and municipal buildings.

According to the Ministry of Infrastructure, the total estimated financial resources required to implement the Program range from UAH 172.91 billion to UAH 934.25 billion for the entire period of its validity (until 2030), the vast majority of which is planned to be covered by extra-budgetary sources (including funds from foreign financial institutions, international financial organizations and technical support programs, etc.)

iii. Description of policies and measures for the introduction of energy services in the public sector, as well as measures to remove regulatory and non-regulatory barriers that impede the introduction of energy performance contracting and other models of energy efficiency service delivery

PM_EE_WEM_03 Energy services in the public sector

Objective: To attract funding for the implementation of measures to improve the energy efficiency of state-owned and municipal facilities.

Legal basis: The Law of Ukraine "On the Introduction of New Investment Opportunities, Guaranteeing the Rights and Legal Interests of Business Entities for Large-scale Energy Modernization"; the Law of Ukraine "On Public Procurement"; the Budget Code of Ukraine; the Law of Ukraine "On Energy Efficiency";.

Timeline: 2015 - indefinitely.

Responsible authorities/organizations: Ministry of Infrastructure; State Agency on Energy Efficiency and Energy Saving.

Description: In 2015, the principles of energy service for state and municipal property (buildings, structures, their groups, objects and/or elements of the improvement facility) were regulated. At the same time, amendments were made to the Budget Code of Ukraine, which allowed budget entities to enter into long-term energy service obligations. Energy service agreements are concluded through public procurement procedures via the Prozorro system. The main criterion for selecting a tender offer is the efficiency indicator of the energy service contract, which is defined as the total value of the discounted differences between the annual cost reductions of the customer and the annual payments to the energy service provider over a twenty-year period. The Cabinet of Ministers of Ukraine has approved an exemplary energy service contract, which is a guideline for budgetary institutions and investors²⁰⁶.

The Law of Ukraine "On Energy Efficiency" expanded the subject matter of an energy service agreement to include systems of engineering structures united by a single technological cycle or their individual energy-consuming equipment. The Law also stipulates that public authorities and local self-government bodies must assess the possibility of entering into an energy service agreement in the case of procurement of electricity, natural gas, heat and hot water supply services. Such assessment will be carried out in accordance with the methodology to be approved by the Ministry of Infrastructure.

In accordance with the Licensing Conditions for Conducting Business Activities in the Field of Heat Supply, approved by the NEURC Resolution No. 308 of 22.03.2017, business entities engaged in heat energy transportation should not take any measures that impede the implementation of energy services and other energy efficiency measures, hinder the development of energy service markets and other energy efficiency measures, including by violating the terms of issuing technical conditions for connection (connection) to networks, abuse of monopoly power, and

²⁰⁶ <https://zakon.rada.gov.ua/laws/show/845-2015-%D0%BF#Text>

The State Agency on Energy Efficiency and Energy Saving ensures the functioning of information databases of potential energy service facilities and energy service providers. However, for the duration of the legal regime of martial law and until its termination, open access to these information databases is temporarily blocked.

As of the end of June 2022, 578 ESCO contracts were concluded in Ukraine for a total amount of more than UAH 1.34 billion²⁰⁷.

In 2023, the Global Environment Facility (GEF) project "Removing Barriers to Promoting Energy Efficiency Investments in Public Buildings in Small and Medium-Sized Cities in Ukraine through the ESCO Mechanism" implemented by the United Nations Development Program (UNDP) reviewed 53 energy service contracts concluded in 2019 in 10 partner cities. The analyzed contracts were aimed at modernizing heating systems and introducing remote energy monitoring of buildings, and one project was aimed at modernizing the outdoor lighting network. Thanks to these projects, the partner cities saved 5.6 thousand Gcal of heat energy and 6.5 million kWh of electricity over four years. The average annual CO2 reduction for 2019-2022 is 1241 tons of CO2 /year²⁰⁸.

According to UNDP²⁰⁹, the energy efficiency contract market in Ukraine is formed by 41 ESCOs, but about 68 percent of the total value of contracts is accounted for by five market players.

A barrier to expanding the use of energy services is the limited access to credit financing for ESCOs and the high cost of credit. According to the financing program from the Entrepreneurship Development Fund

Planned activities: To develop this policy instrument, the Ministry of Infrastructure envisages the following measures:

- reimbursement of part of the interest on loans taken out by them for the comprehensive thermal modernization of state-owned and municipal buildings - I quarter of 2024;
- Ensuring liquidity of energy service contracts as an investment asset, in particular in preparation for the implementation of pension reform and filling pension funds with "green" investment assets, as well as regulating the possibility of entering into factoring agreements - Q1 2024;
- introduction of short express courses and route maps on technical supervision in the field of construction for those responsible for public procurement of energy services and acceptance of works and services - III quarter of 2024;
- Amendments to the legislation on 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 low-income households - IV quarter of 2025²¹⁰.

iv. Other planned policies, measures and programs to achieve the indicative national energy efficiency contributions by 2030, as well as other targets referred to in paragraph 2.2 (e.g., measures to ensure the role of exemplary public buildings and energy-efficient public procurement, measures to introduce energy

²⁰⁷<https://www.kmu.gov.ua/news/enerhoservis-diievyi-instrument-zaluchennia-investytsii-u-modernizatsiui-biudzhetnykh-ustanov>

²⁰⁸<https://www.undp.org.uk/ukraine/publications/ohlyad-naykrashchych-praktyk-dyzaynu-rynku-esko-ta-rekomendatsiyi-dlya-ukrayiny>

²⁰⁹ <https://www.undp.org/sites/g/files/zskgke326/files/2023-05/ukrainian.pdf>

²¹⁰ Operational Action Plan for the implementation in 2024-2026 of the Long-Term Strategy for Thermal Modernization of Buildings for the period up to 2050, approved by the Cabinet of Ministers of Ukraine No. 1228 of 29.12.2023: <https://zakon.rada.gov.ua/laws/show/1228-2023-%D1%80#Text>

audits and energy management systems, measures to inform and educate consumers, and other measures to improve energy efficiency)

PM_EE_WEM_04 Minimum requirements for energy efficiency of buildings

Objective: To set the maximum allowable energy consumption per unit area or volume in new and existing buildings.

Legal basis: The Law of Ukraine "On Energy Efficiency of Buildings", Order of the Ministry of Regional Development, Construction, Housing and Communal Services of Ukraine No. 170 of 11.07.2018 "On Approval of the Methodology for Determining the Economically Feasible Level of Energy Efficiency of Buildings", Order of the Ministry of Community and Territorial Development No. 260 of 27.10.2020 "On Approval of the Minimum Requirements for Energy Efficiency of Buildings".

Timeframe: 2021 - indefinitely.

Responsible authorities/organizations: Ministry of Infrastructure.

Description: Minimum energy efficiency requirements for buildings are calculated on the basis of an economically feasible level and reviewed at least every 5 years. Limit values of specific energy consumption for heating and cooling of residential buildings should be from 65 to 120 kWh/sq.m (depending on the number of storeys of the building and temperature zone). In case of reconstruction or major repairs, a correction factor of 1.2 is applied to these values. The current minimum requirements were adopted in 2020 and entered into force on January 04, 2021.

According to the Long-Term Strategy for Thermal Modernization of Buildings for 2030, at least 36 percent of residential buildings must meet the minimum requirements for building energy efficiency by 2030; this share should increase to 71 percent in 2040.

Planned activities: As part of the practical implementation of the "Build Back Better" principle, the Government will revise the minimum requirements for energy efficiency of buildings. The Ministry of Infrastructure will approve updated minimum requirements for energy efficiency of buildings in the fourth quarter of 2025.²¹¹

PM_EE_WAM_03 Buildings with near-zero energy consumption

Objective: To stimulate the construction and thermal modernization of buildings with the highest level of energy efficiency.

Legal basis: The Law of Ukraine "On Energy Efficiency of Buildings", the Concept of Implementation of the State Policy in the Field of Energy Efficiency of Buildings in terms of Increasing the Number of Buildings with Close to Zero Energy Consumption and the National Plan for Increasing the Number of Buildings with Close to Zero Energy Consumption.

Timeframe: 2025 - indefinitely.

Responsible authorities/organizations: Ministry of Infrastructure

Description: In pursuance of the requirements of Directive 2010/31/EU and the Law of Ukraine "On Energy Efficiency of Buildings", the Concept for the Implementation of State Policy in the Field of Energy Efficiency of Buildings in terms of increasing the number of buildings with near-zero energy consumption

²¹¹ Operational Action Plan for the implementation in 2024-2026 of the Long-Term Strategy for Thermal Modernization of Buildings for the period up to 2050, approved by the Cabinet of Ministers of Ukraine No. 1228 of 29.12.2023: <https://zakon.rada.gov.ua/laws/show/1228-2023-%D1%80#Text>

and the National Plan for Increasing the Number of Buildings with Near-Zero Energy Consumption were adopted in 2020.

According to the Concept, it is planned that no later than December 31, 2027, the energy efficiency class of all buildings put into operation should not be lower than the requirements for energy-independent buildings in force at the date of commencement of construction work, and no later than December 31, 2025, the energy efficiency of state-owned and municipally owned buildings put into operation should not be lower than the requirements for energy-independent buildings in force at the date of commencement of construction work. The Concept also defines maximum indicators of specific primary energy consumption for energy-independent buildings (new construction):

- from 46 to 92 kWh/sq.m for residential buildings (depending on the number of storeys and temperature zone);
- from 21 to 33 kWh/cubic meter for public buildings (depending on the number of floors and temperature zone);
- 33 to 35 kWh/cubic meter for buildings and structures of educational and healthcare institutions (depending on the temperature zone).

The long-term strategy for thermal modernization of buildings stipulates that at least 10% of public buildings will meet the requirements of near-zero energy buildings in 2030, and in 2040 at least 25% of residential buildings are expected to meet these requirements.

In order to establish mandatory compliance with the requirements for buildings with near-zero energy consumption, it is necessary to approve building codes for the design and construction of such buildings. The requirements for buildings with near-zero energy consumption and the procedure for monitoring the number of such buildings will be approved in the fourth quarter of 2024. The monitoring of compliance with the requirements for buildings with near-zero energy consumption and the definition of categories of public buildings, as well as the implementation of regulatory and legal regulation, ensuring actual compliance with such requirements are planned for the fourth quarter of 2025.²¹²

PM_EE_WEM_05 Certification of energy efficiency of buildings

Objective: To assess the compliance of the energy characteristics of the building and its elements with the established minimum requirements for energy efficiency of buildings.

Legal basis: The Law of Ukraine "On Energy Efficiency of Buildings", Order of the Ministry of Regional Development, Construction, Housing and Communal Services of Ukraine No. 169 dated July 11, 2018 "On Approval of the Methodology for Determining the Energy Efficiency of Buildings", Order of the Ministry of Regional Development, Construction, Housing and Communal Services of Ukraine No. 172 dated July 11, 2018 "On Approval of the Procedure for Energy Efficiency Certification and the Form of Energy Certificate".

Timeframe: 2018 - indefinitely.

Responsible authorities/organizations: Ministry of Infrastructure; State Agency on Energy Efficiency and Energy Saving.

²¹² Operational Action Plan for the implementation in 2024-2026 of the Long-Term Strategy for Thermal Modernization of Buildings for the period up to 2050, approved by the Cabinet of Ministers of Ukraine No. 1228 of 29.12.2023: <https://zakon.rada.gov.ua/laws/show/1228-2023-%D1%80#Text>

Description: Energy efficiency certification 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 efficiency 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 for Energy Efficiency Certification, Energy Audit of Buildings and Inspection of Technical Installations, approved by the Resolution of the Cabinet of Ministers of Ukraine No. 40 of January 16, 2024.

They are subject to mandatory certification:

- construction projects;
- buildings where it is intended to carry out thermal modernization and/or insulation, for which state support is provided;
- state-owned buildings that house executive authorities and occupy more than 250 square meters of heated space;
- municipally owned buildings that house local governments and occupy more than 250 square meters of heated space;
- municipal buildings with a heated area of more than 250 square meters that are frequently visited by citizens.

Information on issued energy certificates for buildings is publicly available on the Portal of the Unified State Electronic System in the Field of Construction. The same portal also contains information on certified specialists in auditing the energy efficiency of buildings and specialists in inspecting engineering systems.

The placement of energy certificates in advertisements for the sale or lease of a building is mandatory, provided that such a certificate is available. Thus, the requirement applies to new or thermally modernized buildings.

The unified state electronic system in the construction sector contains 19,318 valid energy certificates for buildings.²¹³

PM_EE_WEM_06 Exemplary role of public authority buildings

Objective: To demonstrate the benefits of energy efficiency measures, increase demand for energy efficient materials and technologies, and increase the number of jobs.

Legal basis: The Law of Ukraine "On Energy Efficiency of Buildings", the draft Concept of the State Targeted Economic Program to Support Thermal Modernization of Buildings until 2030.

Timeframe: 2021 - indefinitely.

Responsible authorities/organizations: Ministry of Infrastructure; State Agency on Energy Efficiency and Energy Saving.

Description: The requirements of Article 5 of Directive 2012/27/EU are transposed by the Law of Ukraine "On Energy Efficiency in Buildings". According to this Law, the Cabinet of Ministers of Ukraine sets a target energy saving indicator for public authority buildings, which is reviewed every five years. The requirement to achieve the energy savings target for public authority buildings applies to buildings that meet all of the following criteria:

- are in state or municipal ownership;

²¹³ As of 04.04.2024. Register of energy certificates: https://e-construction.gov.ua/document/optype=13/filter=337_1

- that house the office of the central executive body;
- the heated area exceeds 250 square meters.

In order to ensure the exemplary role of public authority buildings, the Concept of the Program to Support Thermal Modernization of Buildings (PM_EE_WAM_02) provides for the following measures:

- certification of the energy efficiency of state-owned and municipally owned buildings that house central executive authorities, other state authorities, their territorial bodies, and local state administrations;
- production of technical passports (technical inventory) of state and municipal buildings that house central executive authorities, other state authorities, their territorial bodies, and local state administrations;
- Implementation of priority energy efficiency measures or thermal modernization projects in buildings (including those using renewable energy sources)
- Ensuring the construction (including the reconstruction of public buildings damaged as a result of hostilities) of state-owned buildings housing public authorities in compliance with the requirements for buildings with close to zero energy consumption.

PM_EE_WEM_07 Energy management in public authorities

Objective: To plan, implement and monitor the results of energy efficiency measures, reduce the financial burden on the budget.

Legal basis: The Law of Ukraine "On Energy Efficiency", the Law of Ukraine "On Energy Efficiency of Buildings", Resolution of the Cabinet of Ministers of Ukraine No. 1460 of December 23, 2021 "On the Implementation of Energy Management Systems".

Timeframe: 2021 - indefinitely.

Responsible authorities/organizations: Ministry of Infrastructure; State Agency on Energy Efficiency and Energy Saving.

Description: The Law of Ukraine "On Energy Efficiency" obliged public authorities, enterprises, institutions and organizations under their management to introduce management systems that will define energy policy, goals, energy targets, and action plans to achieve the goals. Energy management systems in public 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 and Energy Saving monitors the implementation of energy management systems and reports to the Government twice a year on the progress made.

As of the end of 2022, 57 state authorities and 19 regional administrations have started implementing energy management. More than 2,800 government buildings are covered by energy monitoring.²¹⁴

In order to simplify the implementation of energy management systems in public authorities, the State Agency on Energy Efficiency and Energy Saving has developed and published a sample (template) of the Order "On Implementation of the Energy Management System"²¹⁵ and a sample (template) of the plan for the implementation of the implementation and operation of the energy management system²¹⁶. The Agency

²¹⁴ https://saee.gov.ua/sites/default/files/SAEE_report_2022.pdf

²¹⁵ https://saee.gov.ua/sites/default/files/blocks/Energy_management_order_EXAMPLE_2023_0.pdf

²¹⁶ https://saee.gov.ua/sites/default/files/blocks/Energy_management_plan_EXAMPLE_2023_0.pdf

is also actively working to raise awareness of approaches to the implementation of energy management systems: in 2022, a series of training seminars was held, attended by 1800 participants.

PM_EE_WEM_08 Energy management in local governments

Objective: Planning, implementation and monitoring of the results of energy efficiency measures, rational use of budget funds.

Legal 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 of 23.12.2021 "On Implementation of Energy Management Systems", Draft Resolution of the Cabinet of Ministers of Ukraine "Some Issues of Energy Management Systems Functioning".

Timeframe: 2021 - indefinitely

Responsible authorities/organizations: Ministry of Infrastructure; State Agency on Energy Efficiency and Energy Saving

Description: The Law of Ukraine "On Energy Efficiency" provides for the implementation of energy management systems by local governments on a voluntary basis, by decision of the relevant council. At the same time, a prerequisite for receiving state support (assistance) for the implementation of energy efficiency measures by local governments is a decision to introduce 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 Energy Management Systems Functioning"²¹⁷, which regulates the implementation of energy management systems and provides an exemplary procedure for using the cost savings resulting from the operation of the energy management system in a local government body.

As of 2021, 225 local governments have implemented energy management or energy monitoring systems, and another 113 are developing such systems.

PM_EE_WEM_09 Local energy plans

Objective: Analyzing the state of energy and other infrastructure, the potential for implementing energy efficiency measures and increasing the share of renewable energy, rational use of budget funds, and identifying priority projects for attracting investment.

Legal basis: The Law of Ukraine "On Energy Efficiency".

Timeframe: 2022-2030.

Responsible authorities/organizations: Ministry of Infrastructure; State Agency on Energy Efficiency and Energy Saving.

Description: The Law of Ukraine "On Energy Efficiency" laid the groundwork for the mandatory implementation of a local energy plan. According to this Law, local governments must develop local energy plans by November 14, 2024. The Ministry of Infrastructure has approved the Procedure for Developing and Updating Local Energy Plans, which should define the composition, content and approach to the preparation of such plans.

The Ministry, together with the U-LEAD (Ukraine - Local Empowerment, Accountability and Development) program, piloted the development of local energy plans in accordance with the approaches defined by the draft Methodology. Another 10 communities are being assisted in the development of local energy plans by the DiXi Group think tank with the support of the Dutch government's MATRA program

²¹⁷ <https://mtu.gov.ua/news/34425.html>

and the European Climate Foundation. The EU STARTER Project is also supporting communities in the preparation of local energy plans, with 6 plans to be prepared. However, such support cannot cover all communities. Measures are needed to strengthen the capacity of communities to develop and update local energy plans and to implement energy efficiency measures by the state.

Another problematic issue is obtaining information by local governments from electricity and natural gas suppliers on the volumes of energy supplied by them and information on energy consumed by consumers located within the territory of the respective administrative unit. The obligation to provide such information is enshrined in the Law of Ukraine "On Energy Efficiency," while the experience of local governments shows that this issue needs to be further regulated. One of the alternatives to solve the policy problem is to enshrine a similar requirement in the Licensing Conditions for Conducting Business Activities for the Supply of Electricity to Consumers and the Licensing Conditions for Conducting Business Activities for the Supply of Natural Gas.

The issue of correlation between local energy plans and sustainable energy and climate action plans adopted by 102 Covenant of Mayors signatory communities also needs to be resolved.

According to the Westminster Foundation for Democracy's study of the application and effectiveness of the Law of Ukraine "On Energy Efficiency", as of January 2023, among 371 surveyed local governments in 198 communities, energy planning has been introduced or plans for implementing energy efficiency measures have been developed in their communities²¹⁸.

PM_EE_WEM_10 Regional offices for decarbonization and energy efficiency

Objective: To strengthen cooperation between central and local government agencies in the implementation of energy efficiency measures.

Legal basis: The Law of Ukraine "On Local Self-Government in Ukraine" (establishment of offices is not an obligation, but is possible in accordance with the powers of local self-government bodies)

Timeframe: 2023 - indefinitely.

Responsible authorities/organizations: State Agency on Energy Efficiency and Energy Saving.

Description: It is envisaged that the State Agency on Energy Efficiency and Energy Saving and the local authorities will cooperate in the following main areas:

- energy management: implementation of energy management systems, development of a local energy plan, energy certification of buildings, and energy audits;
- Identification and utilization of the potential for substitution of traditional fuels, alternative heat supply, high-efficiency cogeneration, biogas and biomethane production;
- attracting financial resources for the energy-efficient transformation of regions (energy services, municipal green finance, international financial assistance, etc.);
- education and popularization of energy efficiency.

As of March 2024, five regional offices have been opened, the first office was opened on November 07, 2023.

PM_EE_WEM_11 Energy efficient procurement

²¹⁸ https://drive.google.com/file/d/1zog_bVhIbHofAolvaScYM1elV56S1hKa/view

Objective: Efficient use of public funds, increasing demand for energy efficient materials and technologies.

Legal basis: The Law of Ukraine "On Energy Efficiency", the Law of Ukraine "On Public Procurement".

Timeframe: 2024 - indefinitely.

Responsible authorities/organizations: Ministry of Economy, Ministry of Infrastructure

Description: In 2020, the Law of Ukraine "On Public Procurement" was amended to allow the use of life cycle cost as a criterion for evaluating tender proposals. The life cycle cost is the total cost of the procurement item or its part (lot) and other costs that will be borne directly by the customer during the use, maintenance and termination of the procurement item. Currently, the Ministry of Economy is implementing a project to expand the use of the life cycle cost method in public procurement.

In addition, the Law of Ukraine "On Energy Efficiency" defines the legal basis for the implementation of energy efficient procurement. When conducting public procurement of energy-consuming goods, the energy efficiency class of such goods must not be lower than the energy efficiency class determined by the Cabinet of Ministers of Ukraine, taking into account the regulatory legal acts in the field of energy labeling, or the energy efficiency indicators of such products (goods) must comply with the indicative indicators determined by the regulatory legal acts in the field of ecodesign, or such products (goods) must comply with the environmental labeling standards of type I. This requirement applies to all customers within the meaning of the Law of Ukraine On Public Procurement. As of February 2024, the permissible energy efficiency classes for energy-consuming goods have not been defined.

In the fourth quarter of 2024, the Ministry of Infrastructure will approve exemplary technical specifications for the procurement of energy-consuming products, as well as monitor the proper application of requirements for energy-consuming products in public procurement. In addition, the Ministry of Economy is expected to develop advisory and explanatory materials on the financial and economic benefits of purchasing highly energy efficient products (goods) in the case of sub-threshold procurement of energy-consuming products (goods)²¹⁹. Thus, energy efficient procurement will be implemented by the end of 2024.

PM_EE_WEM_12 Energy labeling and eco-design

Objective: Reduce final energy consumption

Legal basis: Law of Ukraine "On Energy Efficiency", Law of Ukraine "On State Market Supervision 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 Regulations for Energy Labeling of Energy Consuming Products", Resolution of the Cabinet of Ministers of Ukraine No. 804 dated 03.10.2018 "On Approval of the Technical Regulations for Establishing a System for Determining the Requirements for Ecodesign of Energy Consuming Products"

Timeframe: 2015 - indefinitely.

Responsible authorities/organizations: Ministry of Infrastructure, Ministry of Economy, State Agency on Energy Efficiency and Energy Saving, State Service of Ukraine on Food Safety and Consumer Protection

Description: 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 the ecodesign of energy-consuming products in

²¹⁹ Operational Action Plan for the implementation in 2024-2026 of the Long-Term Strategy for Thermal Modernization of Buildings for the period up to 2050, approved by the Cabinet of Ministers of Ukraine No. 1228 of 29.12.2023: <https://zakon.rada.gov.ua/laws/show/1228-2023-%D1%80#Text>

accordance with EU legislation. In Ukraine, there are 2 framework technical regulations, 24 technical regulations establishing requirements for the ecodesign of certain groups of energy-consuming products, and 15 technical regulations on energy labeling.

The State Service of Ukraine on Food Safety and Consumer Protection provides market oversight of compliance with eco-design and energy labeling requirements.

Results: In 2021, 118 inspections of the characteristics of energy-consuming goods were carried out. Based on the results of the inspections, 131 restrictive (corrective) measures were adopted, namely:

- 130 decisions to restrict the supply of goods on the market;
- 1 decision to ban the provision of goods on the market.

We also checked the characteristics of energy-consuming goods with the selection of samples for examination (testing), in particular, lamps, light bulbs, and LED lamps. Out of 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 of 13.03.2022 "On Termination of State Supervision (Control) and State Market Supervision Measures under Martial Law".

PM_EE_WEM_13 Pilot project on creation of favorable conditions for efficient electricity consumption in Ukraine

Objective: Reduce final energy consumption, reduce the load on the energy system, and change behavior.

Legal basis: Resolution of the Cabinet of Ministers of Ukraine No. 25 dated 10.01.2023 "On the Implementation of a Pilot Project to Create Favorable Conditions for Ensuring Efficient Electricity Consumption in Ukraine".

Timeframe: 2023-2024.

Responsible authorities/organizations: Ministry of Economy

Description: The Ministry of Economy is implementing a pilot project to replace 50 million incandescent lamps with new LED lamps. Citizens of Ukraine who have reached the age of 18 and certain categories of legal entities are eligible to participate in the project: healthcare, education, culture, social protection institutions (municipal and state-owned), physical culture and sports institutions (municipal), managers of apartment buildings, and associations of apartment building co-owners. Individuals can receive up to five energy-efficient lamps, while legal entities can receive 2 or 3 lamps for every 10 m², depending on the type of premises. The lamps are delivered through Ukrposhta offices.

The project is supported by 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 pilot project, the approach to the gradual withdrawal of incandescent lamps from the Ukrainian market will be determined.

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 condominiums - 274,619 units). 16.39 million incandescent light bulbs were recycled. Estimated energy savings amounted to 1.17 GWh.

PM_EE_WEM_14 Energy audit of large enterprises

Objective: To analyze the energy consumption profile and identify optimal energy efficiency measures

Legal basis: The 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".

Timeframe: 2021 - indefinitely.

Responsible authorities/organizations: Ministry of Infrastructure

Description: The Law of Ukraine "On Energy Efficiency" introduced mandatory energy audits by large businesses every four years. As of 2022, 494 enterprises were subject to this requirement. The first energy audits should be conducted by 14.11.2024. In December 2023, the Procedure for Conducting and Requirements for Energy Audits of Processes and Transport was adopted, which regulates the procedures for preparing, conducting and documenting the results of energy audits of processes and transport, as well as the minimum requirements for the form and content of the report and an extract from the energy audit report. Energy audits should be conducted in accordance with national standards harmonized with the 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 scope of energy audits are determined by the customer. In the future, this may lead to a situation in which mandatory energy audits of companies operating in the same industry will be incomparable.

Mandatory energy audits may be conducted by energy auditors who have passed the qualification confirmation in the areas of buildings, processes or transport. The procedure for confirming the qualifications of persons who intend to carry out energy audits and the qualification requirements for energy auditors must be approved by the Cabinet of Ministers of Ukraine. As of early February 2024, such regulations have not been adopted. Thus, large businesses are unable to comply with the requirements of the Law of Ukraine "On Energy Efficiency".

Alternatively, large businesses have the right to implement energy and/or environmental management systems. Such systems must be certified in accordance with ISO 50001 and/or ISO14001.

As part of the public consultations on the NECP, participants noted that the state sets requirements for mandatory energy audits, but does not provide opportunities to implement energy efficiency measures. The main barrier to improving the energy efficiency of enterprises is the complexity and high cost of attracting financing. As of 2024, there is a lack of systematic government support for the implementation of energy efficiency measures by enterprises. Ukraine has separate programs of donors and international financial organizations (IFIs) to support such measures: UNIDO Loan Guarantee Fund²²⁰, KfW Energy for Business Program²²¹, Finnish-Ukrainian Trust Fund (program completed)²²². The results of these programs can be used as an analytical basis for designing government support programs. The draft Strategy for the Recovery, Sustainable Development and Digital Transformation of Small and Medium-Sized Enterprises until 2027²²³, developed by the Ministry of Economy, envisages the introduction of a program of vouchers for professional energy audits and subsidies for energy efficiency for micro and small businesses. In particular, energy audits are expected to be conducted at a number of enterprises in such sectors as agriculture, forestry, fisheries, mining and quarrying, processing industry, electricity, natural gas, water supply and sewage, waste management, and construction. Among the measures in the Energy Efficiency area, the ESU envisages the launch of a state program of financial support for energy efficiency for small and medium-sized enterprises.

²²⁰ <http://www.ukriee.org.ua/uk/proekt/komponenti/komponent-3-finansoviy-mekhanizm/>

²²¹ <https://bdf.gov.ua/programs/prohrama-doday-enerhiyi-tvoyemu-biznesu/>

²²² <https://saei.gov.ua/uk/content/finland-ukraine-trust-fund>

²²³ https://www.me.gov.ua/Documents/Detail?lang=uk-UA&id=454b13bc-3503-4185-b59d-b60f6467748c&title=ProjectStrategiiVidnovlennia-StalogoRozvitkuTaTsifrovoiTransformatsiiMalogoTaSerednogoPidprymitstvaNaPeriodDo2027-Roku&fbclid=IwAR3tv4Zf_xZliuhKg38ppQFaL924oxRcPygt4byALbnSC9KRu5T8mZkfRvA

In addition, the State Fund for Decarbonization and Energy Efficient Transformation (PM_EE_WEM_02) can potentially support energy efficiency measures for enterprises.

v. If applicable, a description of policies and measures to enhance the role of local RES communities in contributing to the implementation of the policies and measures referred to in points i, ii, iii and iv

At present, the provisions of Directive (EC) 2018/2001 on the operation and promotion of RES communities have not been fully transposed into Ukrainian legislation. The Law of Ukraine "On Alternative Energy Sources" regulates incentives for one type of RES community - energy cooperatives. Energy cooperatives have the opportunity to receive a "green" tariff for the electricity they produce or to receive incentives through the mechanism of self-production (net-billing).

The NEURC has developed the draft Law of Ukraine "On Amendments to Certain Laws of Ukraine on Transposition of Acts of the Energy Community", which, among other things, regulates the activities of energy consumer associations. The provisions of this draft law are aimed at transposing the requirements of Directive (EU) 2019/944. This draft law provides for the possibility of providing energy efficiency services by energy consumer associations. At the same time, it does not specify what kind of services these are, as well as the rights and obligations of energy consumer associations in connection with the provision of such services.

In addition to finalizing the legislation to expand the role of RES communities, it is also necessary to take measures to raise awareness among the population and local government representatives about the benefits of establishing energy cooperatives. Such activities can be carried out by regional offices of decarbonization and energy efficiency, as well as the State Agency on Energy Efficiency and Energy Saving.

vi. Description of measures aimed at developing measures to utilize the energy efficiency potential of gas and electricity infrastructure

PM_EE_WAM_04 Assessment of the energy efficiency potential of the gas transmission system, electricity transmission system, gas distribution system, electricity distribution system

Objective: to improve the efficiency of energy networks and stimulate investment in energy efficiency measures.

Legal basis: The Law of Ukraine "On Energy Efficiency"

Timeframe: 2021 - indefinitely.

Responsible authorities/organizations: Ministry of Energy, NEURC, State Agency on Energy Efficiency and Energy Saving

Description: The transmission system operator and operators of electricity distribution systems, the gas transmission system operator and operators of gas distribution systems shall assess the energy efficiency potential of the 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 still under development.

At the same time, transmission, transportation, and distribution system operators are subject to mandatory energy audits (for more details, see 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 requirement to conduct an energy audit is included in the license conditions for conducting business activities for electricity

transmission; electricity generation; electricity supply to the consumer; electricity distribution;²²⁴ license conditions for conducting business activities for heat generation; heat transportation by main and local (distribution) heating networks, and heat supply. .²²⁵

According to the NEURC Resolution No. 222 of 30.01.2024 "On Approval of Amendments to the Procedure for Monitoring Compliance by Licensees Operating in the Energy and Utilities Sectors with the Legislation in the Relevant Sectors and License Terms"²²⁶, the Regulator may impose fines on licensees in the amounts stipulated, in particular, by the Law of Ukraine "On Energy Efficiency"²²⁷. At the same time, the amount of fines for failure to conduct mandatory energy audits in accordance with this Law has not been established as of February 2024.

PM_EE_WEM_15 Intelligent energy metering systems

Goal: *to* promote the active participation of consumers in regulating their consumption (demand management), as well as other electricity market participants in providing balancing and ancillary services, and to obtain accurate information for generating bills based on actual energy consumption and actual consumption time.

Legal basis: The Law of Ukraine "On Energy Efficiency", the Code of Commercial Metering of Electricity, approved by the NEURC Resolution No. 311 of 14.03.2018.

Timeline: 2018 - indefinitely.

Responsible authorities/organizations: Ministry of Energy, NEURC.

Description: In accordance with the Law of Ukraine "On Energy Efficiency", the transmission system operator and operators of electricity distribution systems, the gas transmission system operator and operators of gas distribution systems shall take measures to install smart metering systems based on an assessment of the technical feasibility and economic feasibility of installing smart metering systems.

The issues of installing smart meters and automated commercial electricity metering systems (ACMS) are regulated by the Code on Commercial Metering of Electricity. Commercial metering administrators must provide the NEURC with the results of an economic analysis of all long-term profits and costs for market participants from the introduction of smart meters and AMR, functional requirements for such equipment, and proposals for an economically feasible and cost-effective method of introducing smart meters and AMR and the timeframe within which this automated metering can be implemented. Commercial metering sites must be equipped with smart meters, which include:

- electrical installations with a connected capacity of 150 kW or more or an average monthly electricity consumption of more than 50 thousand kWh at consumer facilities (except for apartment buildings and household consumers);
- generating facilities and/or energy storage facilities with the ability to supply electricity to power grids;
- of the consumer's electrical installation at the consumer's initiative.

²²⁴ <https://www.nerc.gov.ua/acts/pro-zatverdzhenya-zmin-do-deyakih-licenziijnih-umov>

²²⁵ <https://zakon.rada.gov.ua/laws/show/v0308874-17#Text>

²²⁶ <https://www.nerc.gov.ua/acts/pro-zatverdzhenya-zmin-do-poryadku-kontrolyu-za-dotrimannym-licenziatami-shcho-provadyat-diyalnist-u-sferah-energetiki-ta-komunalnih-poslug-zakonodavstva-u-vidpovidnih-sferah-ta-licenzijn-7>

²²⁷ <https://www.nerc.gov.ua/storage/app/uploads/public/647/a27/0a6/647a270a68097079576461.pdf>

The issue of intelligent natural gas metering systems is described in the policy PM_IMG_WAM_15 Telemetry Benefit-Cost Analysis.

As of the end of 2022, 2.2 million smart meters with remote reading and control were installed in households. Another 464 thousand such meters were planned to be installed in 2023. The average level of smart meter coverage for residential consumers is 12.4%²²⁸. Data on non-household consumers is not available.

PM_EE_WEM_16 Regulation of combined heat and power (cogeneration)

Objective: to create a legal framework for increasing the efficiency of fuel use in energy production or other technological processes, and for the development and application of cogeneration technologies.

Legal basis: The Law of Ukraine "On Combined Heat and Power Generation (Cogeneration) and Use of Waste Energy Potential"

Time frame: 2005 - indefinitely.

Responsible authorities/organizations: Ministry of Infrastructure, NEURC, Ministry of Energy.

Description: The state policy in the field of cogeneration plants is based on the following principles:

- facilitating the conversion of existing heat generating facilities into combined heat and power plants;
- creation of distributed (local) power generating capacities as a condition for increasing the reliability and security of energy supply at the regional level;
- economic incentives for the use of cogeneration units at enterprises regardless of ownership and industry.

The Law defines cogeneration incentives as providing owners (users) of cogeneration plants with the right to have unimpeded access to local (local) power grids and to sell the generated electricity to individual consumers under contracts, including the right to supply electricity to consumers during the hours of the day of the highest or average load of the power grid (peak and semi-peak periods of the day) simultaneously (additionally) with the main electricity supplier.

The Law of Ukraine "On Heat Supply" includes the introduction of cogeneration units, including on the basis of existing heating boilers, among the areas of development of heat supply systems.

In 2023, a number of legislative changes were developed to increase the number of cogeneration units:

- provides for a simplified procedure for connecting individual energy consumers to the networks of electricity producers at cogeneration units (CCGTs) with a capacity of up to 20 MW. Such producers have the right to supply electricity to their own critical infrastructure facilities via internal power supply networks or critical infrastructure facilities (with the approval of local governments);
- regulates the peculiarities of legal relations between consumers and producers of electricity at CCGTs with a capacity of up to 20 MW for the period of emergency or planned suspension or limitation by the electricity distribution/transmission system operator. In this case, electricity may be provided under a backup power supply agreement. Backup power supply to consumer facilities is not an activity of electricity supply and distribution/transmission, and can be carried out exclusively by power grids that are separated from the IPS of Ukraine;

²²⁸ <https://map.ua-energy.org/uk/resources/b676f89a-188b-4179-8d56-1b984a2e477f/>

- the peculiarities of connection of critical infrastructure facilities with a capacity of up to 20 MW to the GCS were regulated;
- exempted from licensing the heat production activities of business entities if heat production is carried out without the purpose of selling it and is consumed for own needs, or is produced by CCGTs with a total nominal active electrical capacity (total installed heat capacity) not exceeding 5 MW (4.3 Gcal/h) and used as a backup source of energy during power outages from the system operator's networks for critical infrastructure and/or heat supply facilities, water pumping stations

As of the end of 2021, the installed capacity of CHP and cogeneration plants was about 6 GW. All large CHP plants were commissioned before Ukraine gained independence. Expected results: The ESU envisages a significant increase in CHP capacity due to the construction of biomass CHP plants, with the capacity of such plants reaching 4.1 GW in 2050.

PM_EE_WAM_05 Update of the Concept for the Implementation of the State Policy in the Field of Heat Supply

Objective: to determine strategic directions for the development of the heat supply sector, taking into account the need to stimulate the transition to efficient district heating.

Legal basis: National Energy and Climate Plan.

Timeline: 2024-2025.

Responsible authorities/organizations: Cabinet of Ministers of Ukraine, NEURC, Ministry of Infrastructure.

Description: Given that the current Concept for the Implementation of the State Policy in the Field of Heat Supply²²⁹ was approved before the concept of "efficient district heating" was introduced into the legislation, this policy document needs to be updated. In particular, the updated version of the Concept should be based on the principle of "energy efficiency first" and contribute to the achievement of efficient district heating indicators: the use of at least 50 percent renewable energy or 50 percent waste heat, or 75 percent heat produced in the process of cogeneration, or 50 percent of the total of such energy and heat).

PM_EE_WAM_06 Ensuring repayment of debt on tariff differences to heat supply companies

Objective: to improve the financial condition of heat supply companies

Legal basis: The Law of Ukraine "On Peculiarities of Regulation of Relations in the Natural Gas Market and in the Heat Supply Sector during Martial Law and Further Restoration of Their Functioning".

Timeline: 2024 p.

Responsible authorities/organizations: Cabinet of Ministers of Ukraine.

Description: On July 29, 2022, the Verkhovna Rada of Ukraine adopted the Law of Ukraine "On Peculiarities of Regulation of Relations in the Natural Gas Market and in the Field of Heat Supply during the Martial Law and Further Restoration of Their Functioning". The Law introduced a moratorium, in particular, on price (tariff) increases in the heat supply sector. At the same time, the Law stipulates that business entities engaged in the production and/or transportation and/or supply of heat energy and the provision of heat energy and hot water supply services subject to the moratorium shall be compensated for the difference in tariffs for the production, transportation and supply of heat energy, heat energy, district heating and district hot water supply services, heat energy and hot water supply services, which

²²⁹ <https://zakon.rada.gov.ua/laws/show/569-2017-%D1%80#Text>

However, in 2022-2023, no compensation was provided for the difference in tariffs, which significantly affected the financial and economic condition of heat supply companies, leading to an increase in accounts payable for energy consumed, penalties and seizure of accounts.

In order to address this situation, the draft Law of Ukraine "On Amendments to the Law of Ukraine "On the State Budget of Ukraine for 2024" regarding compensation of the difference in tariffs" (Reg. No. 10383 of 29.12.2023) has been registered. In addition, in accordance with the Memorandum with the International Monetary Fund (IMF), an audit of the tariff difference debt and the financial condition of the heating companies should be conducted by the end of June 2024.

PM_EE_WAM_07 Assessment of the potential for efficient district heating and highly efficient cogeneration

Objective: to increase the efficiency of heat production and transportation, identify the optimal set of energy efficiency measures, and stimulate investment in energy efficiency measures.

Legal basis: The Law of Ukraine "On Energy Efficiency"; the Law of Ukraine "On Amendments to the Law of Ukraine "On Combined Heat and Power Production (Cogeneration) and Use of Waste Energy Potential" regarding the Development of Highly Efficient Cogeneration"

Timeframe: 2021 - indefinitely.

Responsible authorities/organizations: Ministry of Infrastructure.

Description: The assessment of the potential for efficient district heating and high-efficiency cogeneration is carried out at the local level and at the national level. At the local level, the assessment of the potential for the use of efficient district heating and high-efficiency cogeneration is a separate section of the heat supply scheme, developed on the basis of a cost-benefit analysis and includes, in particular

- description and map of the territory indicating existing and potential heat consumption facilities, existing and planned heat supply facilities, potential heat sources, including industrial plants or other facilities that generate waste heat;
- Assessment of the energy and technical potential of using efficient district heating and highly efficient cogeneration;
- calculation of the primary energy saving target;
- Assessment of local, regional, national and international programs to support the production, transportation and supply of heat energy, indicating, if any, the potential share of non-repayable assistance.

Assessment of the potential for the use of high-efficiency cogeneration is mandatory at the level of individual plants in case of a significant upgrade of an existing or construction of a new heat generating plant (with a thermal capacity of more than 20 MW) before the start of its construction, overhaul, 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 Production (Cogeneration) and Use of Waste Energy Potential" regarding the development of highly efficient cogeneration" (effective as of 03/22/2024) should be brought into line with Directive 2012/27/EU.

The Ministry of Infrastructure must approve a national report on a comprehensive assessment of the potential for the use of efficient district heating and high-efficiency cogeneration every five years and submit it to the Energy Community Secretariat. Currently, secondary legislation to regulate the preparation of the national report is under development.

PM_EE_WEM_17 Heat supply schemes

Objective: to plan the most cost-effective heat supply to a settlement, reduce the amount of energy resources required for the production, transportation and supply of a unit of heat energy to consumers.

Legal basis: The Law of Ukraine "On Heat Supply"; Order of the Ministry of Communities and Territories Development of Ukraine No. 235 of 02.10.2020 "On Approval of the Methodology for Developing Heat Supply Schemes for Settlements of Ukraine"

Time frame: 2005 - indefinitely.

Responsible authorities/organizations: Ministry of Infrastructure.

Description: The heat supply scheme is a tool for long-term planning of heat supply to settlements, which is formed on the basis of the optimal combination of centralized and autonomous heat supply systems. The basis for developing a heat supply scheme is the master plan of the settlement. Heat supply schemes are developed using the method of benefit-cost analysis to select the recommended heat supply scenario. Long-term planning of the heat supply of a settlement is aimed at developing efficient district heating systems, with the gradual replacement of traditional heat sources using natural gas with natural gas:

- combined heat and power plants (cogeneration units);
- installations that use renewable energy sources;
- installations for utilizing waste heat energy.

When developing heat supply schemes, the areas of application for centralized, autonomous and individual heat supply systems are determined.

Such documents are valid for 10 years. For settlements with more than 20,000 inhabitants, heat supply schemes are approved by the Ministry of Infrastructure, while in other settlements they are approved by local governments.

To ensure compliance with the principle of "energy efficiency first", projects for modernization of heat sources and heating networks should be developed after the development of thermal modernization of buildings. Currently, thermal modernization is being implemented in single buildings, however, the Long-term Strategy for Thermal Modernization of Buildings until 2050 envisages a significant increase in the scale of thermal modernization. The thermal modernization of buildings and district heating systems should be carried out in a coordinated manner as part of an integrated approach to addressing these interrelated challenges.

As of November 2023, heat supply schemes were approved and remain in effect in 30 settlements with more than 20,000 inhabitants. Another 96 communities need to develop or update their heat supply schemes.

PM_EE_WEM_18 Qualification of cogeneration units

Objective: to establish compliance of the conditions and performance indicators of the cogeneration unit with the requirements of the law.

Legal basis: The Law of Ukraine "On Combined Heat and Power Production (Cogeneration) and Use of Waste Energy Potential"; the Law of Ukraine "On Amendments to the Law of Ukraine "On Combined Heat and Power Production (Cogeneration) and Use of Waste Energy Potential" regarding the Development of Highly Efficient Cogeneration"

Timeframe: 2024 - indefinitely.

Responsible authorities/organizations: State Agency on Energy Efficiency and Energy Saving

Description: Cogeneration plants that sell part or all of their electricity to consumers can be recognized as qualified if they meet one of the following two conditions:

- waste energy potential of technological processes is used as the main fuel; heat production is not required for such plants.
- fossil fuels are used as the main fuel, and the amount of heat supplied must be at least 10 percent of the total production of electricity and heat within one year from the date of its commissioning and within each of the following 12 months; during this period, the amount of electricity and heat supplied in relation to the energy of the main and additional fuel must be at least 42 percent.

The qualification of cogeneration units is carried out by the State Agency on Energy Efficiency and Energy Saving 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 a Cogeneration Unit".

The Law of Ukraine "On Amendments to the Law of Ukraine "On Combined Heat and Power Production (Cogeneration) and Use of Waste Energy Potential" regarding the Development of Highly Efficient Cogeneration" stipulates that cogeneration plants may be recognized as qualified if they are highly efficient cogeneration plants, and also defines qualification requirements for such plants.

Policy incentives for the use of qualified cogeneration units include a 3.2% excise tax exemption (sub-clause 213.2.8 of clause 213.2 of Article 213 of the Tax Code of Ukraine) on the sale of electricity generated by qualified cogeneration units and the possibility of obtaining guarantees of origin for electricity generated by a highly efficient cogeneration unit. Starting from 22.03.2024, the excise tax exemption will apply exclusively to highly efficient cogeneration.

In 2022, 39 cogeneration units of 24 business entities were qualified in Ukraine.

PM_EE_WAM_06 Guarantees of origin of electricity produced by a highly efficient cogeneration unit

Objective: to provide end-users of electricity with information that electricity is produced by a highly efficient cogeneration unit.

Legal basis: The Law of Ukraine "On Amendments to the Law of Ukraine "On Combined Heat and Power Production (Cogeneration) and Use of Waste Energy Potential" regarding the Development of Highly Efficient Cogeneration"

Timeframe: 2024 - indefinitely.

Responsible authorities/organizations: State Agency on Energy Efficiency and Energy Saving.

Description: The owner (user) of a high-efficiency cogeneration unit has the right to obtain a guarantee of origin of electricity generated by a high-efficiency cogeneration unit. 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 supplied to the grid, which is determined to the nearest 1 MWh. The guarantee of origin is valid for 12 months. In order to obtain guarantees of origin for the generated electricity, the owner (user) of a high-efficiency cogeneration unit must first qualify the cogeneration unit.

PM_EE_WAM_07 Stimulating the development of highly efficient cogeneration

Objective: to stimulate investment in highly efficient cogeneration.

Legal basis: The Law of Ukraine "On Combined Heat and Power Generation (Cogeneration) and Use of Waste Energy Potential".

Timeframe: 2025 - indefinitely.

Responsible authorities/organizations: Ministry of Infrastructure.

Description: Among the key measures to ensure distributed local generation, it is necessary to stimulate the installation of new cogeneration units. There is a significant potential for the IPS to interact with existing district heating systems to balance wind and solar power plants. To realize this potential, as well as to ensure stable electricity and heat supply, it is necessary to build new maneuverable cogeneration units. Such plants can be supplemented by heat pumps or electric boilers together with thermal accumulators to use excess electricity during nighttime dips in the electricity load schedule for heat production and storage.

The guarantees of the origin of electricity produced by a high-efficiency cogeneration unit provided for by the Law of Ukraine "On Amendments to the Law of Ukraine "On Combined Heat and Power Production (Cogeneration) and Use of Waste Energy Potential" regarding the development of high-efficiency cogeneration" (2955-IX of 24.02.2023) are not a sufficient incentive to attract financing for the construction of new facilities. In view of this, it is proposed to plan an assessment of policy alternatives for the construction of new high-efficiency cogeneration facilities and the development of relevant legislative changes.

PM_EE_WEM_19 Ensuring heat energy metering

Objective: to provide consumers with accurate information on the amount of utilities consumed (heat supply, hot water supply, centralized water supply).

Legal basis: The Law of Ukraine "On Commercial Metering of Heat Energy and Water Supply"; Order of the Ministry of Regional Development, Construction, Housing and Communal Services of Ukraine No. 206 of 09.08.2018 "On Approval of the Procedure for Equipping Buildings with Commercial Metering Units and Equipment of Engineering Systems to Ensure Such Metering"; Order of the Ministry of Regional Development, Construction, Housing and Communal Services of Ukraine No. 205 of 09.08.2018 "On Approval of the Procedure for Equipping Separate Premises in Buildings with Distribution Metering Units/Units

Timeframe: 2017 - indefinitely.

Responsible authorities/organizations: Ministry of Infrastructure; State Agency on Energy Efficiency and Energy Saving.

Description: 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 buildings with commercial metering units for the relevant utilities. New residential and non-residential buildings that have been completed are only accepted for operation if they are equipped with appropriate commercial and distribution metering units.

The obligation to install commercial metering units is imposed on 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 equip the building with commercial metering units in accordance with the procedure established by law. The costs of the operator of external engineering networks for equipping existing buildings with commercial water and heat metering units are included in the tariffs for the relevant utilities. The Law also provides for the possibility to allocate funds for equipping existing buildings with commercial metering units from local budgets and the state budget.

100 percent commercial metering of heat energy must be ensured within 24 months from the date of termination or lifting of martial law in Ukraine. Initially, the achievement of this indicator was planned for 03.08.2018, later postponed to 01.09.2022, and postponed for the third time by the Law of Ukraine No.

2479-IX of 29.07.2022. To ensure 100 percent heat metering, it is necessary to assess the necessary financial resources and establish the obligation to include the necessary funds in the investment programs of external engineering network operators or to provide funding from other sources (funding from the State Target Economic Program for Energy Modernization of Enterprises - Heat Producers).

The Law of Ukraine "On Commercial Metering of Heat Energy and Water Supply" also regulates the distribution metering of heat energy. The installation of heat distribution metering units is mandatory for new residential and non-residential buildings. If it is not technically possible to equip the centralized heating system of a building with distribution metering units, the distribution metering of consumed heat energy in individual rooms in buildings is carried out using heat energy distributors, unless it is economically impractical. The readings of heat energy distributors shall be used to distribute the amount of heat energy consumed in the building only if at least 50 percent of the heating devices (except for those located in the common areas of apartment buildings) in the building are equipped with such devices.

As of January 20, 2024, 84.9 percent of residential buildings and 83.9 percent of non-residential buildings are equipped with commercial heat metering units²³⁰.

PM_EE_WAM_08 Implementation of the State Target Economic Program for Energy Modernization of State-owned or Municipally Owned Heat Producers for the Period up to 2030

The goal is to increase the efficiency of district heating systems in settlements, reduce the specific consumption of fuel and energy resources and increase the share of renewable energy, waste heat, and heat produced in cogeneration in district heating systems.

Legal basis: The Law of Ukraine "On Energy Efficiency"; Order of the Cabinet of Ministers of Ukraine No. 1093 of 28.11.2023 "On Approval of the Concept of the State Target Economic Program for Energy Modernization of Enterprises - Heat Producers in State or Communal Ownership for the Period up to 2030"

Timeline: 2024-2030.

Responsible authorities/organizations: Ministry of Infrastructure.

Description: Measures envisaged by the Concept of the State Target Economic Program for Energy Modernization of Enterprises - Heat Producers in State or Communal Ownership for the period up to 2030 include:

- support and incentives for local governments to develop and update heat supply schemes for settlements by reimbursing part of the cost of the work;
- reimbursement to local governments of a portion of the cost of developing and updating heat supply schemes for settlements;
- incentives for heat supply companies to equip consumer buildings with commercial metering units (including remote data transmission) to ensure 100 percent commercial metering of heat energy.
- Providing co-financing for local governments and heat supply companies to equip buildings with individual heating stations with automatic regulation depending on changes in weather conditions.
- partial reimbursement of the cost of major repairs and reconstruction of heat supply facilities to local governments and heat supply companies;
- partial reimbursement to local governments and heat supply companies for the cost of measures envisaged by the current heat supply scheme.

Expected results of the Program:

²³⁰ https://saei.gov.ua/sites/default/files/Oblik_20_01_2024.pdf

- reduction of annual natural gas consumption by more than 1 billion cubic meters;
- Reduction of annual greenhouse gas emissions in the amount of about 2 Mt CO₂-eq;
- Reduction of specific consumption of conventional fuel for heat production to 150 kg of fuel equivalent/Gcal;
- reducing the share of heat losses in heating networks by up to 11 percent;
- increase the share of alternative energy sources in heat production to 30 percent;
- ensuring 100 percent commercial metering of heat energy.

The Ministry of Infrastructure sees the expected cost of modernizing Ukraine's district heating systems in the range of EUR 4-15 billion.

vii. Regional cooperation in this area, if applicable.

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viii. Funding measures, including Union support and use of Union funds, in this area at the national level

Name of the funding program	Source of funding.	Implementatio n period	Amount of funding	Objective.
State Target Economic Program for Energy Efficiency and Development of Energy Production from Renewable Energy Sources and Alternative Fuels for 2010-2021	State budget of Ukraine	2010-2021	UAH 3.8 billion	Bringing the energy intensity of Ukraine's gross domestic product closer to the level of developed countries and EU standards, optimizing the structure of the country's energy balance.
Energy Efficiency Fund	State budget of Ukraine	2018-2023	UAH 2.8 billion	Supporting the implementation of measures to improve the energy efficiency of buildings, in particular in the residential sector, and reduce carbon dioxide emissions
Decarbonization and Energy Efficiency Transformation Fund	State budget of Ukraine	2023	UAH 759.2 million	Providing a sustainable source of funding to support government programs for energy efficiency, alternative energy sources and decarbonization.
Support program energy efficiency in Ukraine - EE4U	European Neighborhood Instrument	2018 - 2025	104 million euro	Supporting the activities of the Ukrainian Energy Efficiency Fund; raising awareness and supporting investments in energy efficiency measures by the general public at the local level, introducing energy saving measures and promoting the Energy Efficiency Fund support mechanisms; training energy auditors to support the

				implementation of energy efficiency reforms and prepare and verify the activities of the Energy Efficiency Fund
Urban infrastructure development project - 2	International Bank for Reconstruction and Development	2014 - 2024	326.6 mln. U.S. DOLLARS	Improving the quality and efficiency of water supply, sewerage and solid waste management services in selected cities of Ukraine.
Project "Improving energy efficiency in the district heating sector of Ukraine"	International Bank for Reconstruction and Development	2014 - 2023	382 million USD. U.S. DOLLARS	To assist the participating utilities in improving economic and energy efficiency, minimizing fuel and energy consumption, improving their institutional capacity, and investing in the reliability of heat supply systems through the reconstruction of district heating 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 reconstructing, upgrading and/or minimizing the deterioration of infrastructure in the following areas: heat supply, water supply and sewage, energy efficiency of buildings, outdoor lighting of settlements, and household waste management.
Project "Energy Efficiency of Public Buildings in Ukraine"	European Investment Bank	2021 - 2025	300 million euros	Improving the energy efficiency of buildings owned by local governments (including kindergartens, hospitals, schools, cultural and administrative buildings).
E5P Foundation "Eastern European Partnership with energy efficiency and the environment"	European Bank for Reconstruction and Development	2009 - 2029	137.5 million euros	Supporting investments in municipal infrastructure that are designed to improve energy efficiency in Ukraine, as well as to have a positive impact on the environment and the fight against climate change
Energy Efficiency in Communities Project	KfW - German Reconstruction Credit Institution	2021 - 2051	35.4 million euros	Improving the energy efficiency of selected public sector buildings in Zhytomyr and Zaporizhzhia through thermal modernization of public buildings, which should contribute to a significant reduction in energy costs for city budgets

Project "Refinancing energy efficiency investments of small and medium-sized enterprises in Ukraine through the financial sector"	KfW - German Reconstruction Credit Institution	2022 - 2052	7.4 million euros	Financing of eligible Ukrainian financial institutions through sub-loans to Ukrainian SMEs and private entrepreneurs to finance energy efficiency investments
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3.3 Energy security dimension

i. Policies and measures related to the elements identified in paragraph 2.3

PM_ES_WEM_01 Development of routes for import of oil products and natural gas

Objective: Maintaining diversification of oil and natural gas supplies; utilization of infrastructure (GTS, oil product pipelines)

Legal basis: ESU

Timeframe: until 2025/2032, depending on the tasks

Responsible authorities: Ministry of Energy

Results: Prior to the full-scale invasion of Ukraine by the Russian Federation, the petroleum products market was 80% dependent on imports, mainly from the Russian Federation and the Republic of Belarus; a significant portion of imports also came by sea. In 2022, the situation changed completely: the destruction of oil refining facilities led to almost 100% import dependence, the blockade of seaports made it impossible to import via this route, and thus a complete diversification of sources and routes of supply of petroleum products and liquefied petroleum gas (LPG) was ensured. In the future, the geography of imports will be influenced by the speed of unblocking seaports and the resumption of oil refining.

Ukraine's Energy Strategy for the period up to 2050 includes strategic initiatives and tasks among its priorities:

- by 2025: diversification of technologies and supply routes to prevent possible energy crises and shortages in case of emergencies.
- By 2032: expansion of oil product supply channels with refineries and EU ports.

In the natural gas market, the goal is to diversify supply routes by 2025 to avoid possible energy crises and shortages in the event of emergencies, including the creation of routes for importing liquefied natural gas (LNG).

A long-term initiative is to create a gas hub, including access to LNG terminals in Poland, Greece, Croatia, Turkey, Italy, and Germany. The practical implementation of the policy will depend on market actors - gas imports from LNG terminals can be realized either through long-term contracts or by purchasing and booking available free volumes on spot markets through swap transactions and adjacent routes. For more details, see Sections 1.2.iii (Key issues of cross-border importance) and 2.4.2.i. (Key infrastructure projects in electricity transmission and gas transportation).

PM_ES_WAM_01 Incentives to increase gas production for maximum self-sufficiency

Objectives: Maintaining diversification of natural gas supplies; utilization of infrastructure (GTS); providing the economy with its own resource

Legal basis: ESU

Timeframe: until 2025/2032, depending on the tasks

Responsible authorities/organizations: Cabinet of Ministers of Ukraine, State Service of Geology and Mineral Resources, Ministry of Energy

Description: The Energy Strategy of Ukraine for the period up to 2050 envisages, among other things, strategic initiatives and tasks:

- by 2025:
 - Increase production under PEC contracts;
 - Implementation of the production sharing agreements signed in 2020-2022 at 11 fields with hydrocarbon deposits;
 - Pilot commercial development of sites that mining companies received through electronic auctions;
 - Active involvement of international service companies with modern technologies by extractive companies;
- by 2032:
 - Attracting investors to sign new PSAs;
 - Amendments to legislation and granting tight gas a separate legal status as a separate mineral resource;
 - Attracting investments to increase gas production at existing fields and developing unconventional gas fields.
 - Adoption of regulations on the rules for restoring the operation of mothballed and abandoned wells.

Subject to the implementation of the strategic initiatives outlined in the ESP, the forecast production volumes by 2030 will amount to approximately 21.5 bcm. Production is expected to start in 2025-2032. By 2032, private companies should reach an annual production of 5.8 bcm, while state-owned companies (Ukrnafta, Ukrgasvydobuvannya) should produce about 15.5 bcm. Total investment is estimated at about UAH 100 billion by 2030.

In the optimistic scenario, by 2032, private companies should reach an annual production of 6.7 billion cubic meters, and state-owned companies - 20.1 billion cubic meters. Total investment is estimated at about UAH 150 billion by 2030. At the same time, reaching a total production volume of 26.8 billion cubic meters will be possible only through investments in new fields, including the development of tight gas reservoirs and the Black Sea shelf.

According to the information received during the working consultations, it is realistic to maintain production volumes at the current level with a slight increase, which will allow for a slight reduction in dependence on imports. The transition to full coverage of domestic consumption in the 2030 horizon is possible if additional measures are taken to support biomethane production and reduce domestic natural gas consumption. Continuation of this policy will allow counting on exporting the remaining volumes (or increasing production of products requiring gas as a raw material) in a later period.

See also the policies and measures of the Internal Energy Market dimension.

PM_ES_WAM_02 Rehabilitation of oil refining and/or construction of a new complex

Objective: To meet the demand for petroleum products through domestic refining

Legal basis: ESU

Timeframe: until 2025/2032, depending on the tasks

Responsible authorities/organizations: Ministry of Energy, Cabinet of Ministers of Ukraine

Description: The Energy Strategy of Ukraine for the period up to 2050, which aims to develop oil production and restore oil refining on the basis of one of the existing refineries and/or build a new complex, includes among its strategic initiatives and tasks:

- by 2025:
 - Establishment of an incentive tax system for the production of liquid hydrocarbons (oil, condensate) within five years from the date of commencement of drilling a new well;
 - Conducting a feasibility study for the resumption of domestic oil refining and starting the relevant preparatory work;
- Until 2032:
 - Facilitate the implementation of selected oil projects by improving geological research and establishing competitive fiscal conditions (including PSAs);
 - Identifying and removing legislative barriers to increasing national production of petroleum products;
 - Stimulate the introduction of new technologies for oil production and treatment that maximize energy efficiency (in particular, at state-owned enterprises);
 - Restore oil refining capacities by modernizing/reconstructing one of the existing refineries and/or building a new complex, where it is most economically feasible;
 - Improving the level of technological equipment of refineries and adding new petrochemical processes, which increases their competitiveness;
 - Analyze the development of small modular refineries;
 - Renewal and expansion of LPG production capacity up to 200 thousand tons per year and condensate production capacity up to 40 thousand tons per year.

The recovery of the industry is focused on a short time horizon relative to the life cycle of refineries, given the decarbonization of transportation, and thus should partially meet the demand for oil products. The rest will be covered by diversified imports to maximize energy security.

A clear perspective for the development of the industry is also an important component of the policy to reduce emissions of methane and non-methane volatile organic compounds during oil and gas processing. In particular, to this end, the draft action plan for the implementation of Ukraine's Updated Nationally Determined Contribution to the Paris Agreement for the period up to 2030²³¹ provides for the development of a draft Concept for the Development of the Gas and Oil Refining Industry, the Market for Oil Products and Gas Fuels of Ukraine (responsible: Ministry of Energy, Ministry of Economy, Ministry of Finance, AMCU, NJSC Naftogaz of Ukraine (by agreement)).

PM_ES_WEM_02 Establishment of fuel cassette manufacturing capacities to meet at least 50% of Ukrainian NPPs' needs

Objective: Increase own production capacity and share in meeting the needs of Ukrainian NPPs

²³¹ <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/>

Legal basis: ESU

Timeframe: 2024-2027

Responsible authorities/organizations: Ministry of Energy, NNEGС Energoatom

Description: Ukraine plans to increase the installed capacity of its nuclear power plants by building new power units and implementing a project for the domestic production of fuel assemblies. The Energy Strategy of Ukraine for the period up to 2050, among its strategic initiatives and tasks until 2032, also envisages the domestic production of nuclear fuel assemblies for NPPs.

By 2025, Energoatom planned to bring its separate Atomenergomash unit to full capacity to produce fuel cassettes to meet all the needs of Ukrainian NPPs²³². In 2021, Atomenergomash began work on establishing the production of nuclear fuel (fuel cassettes) using Westinghouse technology to completely replace fuel of Russian origin. On January 17, 2022, Energoatom and Westinghouse signed an agreement on the assessment and qualification of fuel assembly production lines. In 2023, the plans were adjusted: "Energoatom plans to develop its own nuclear fuel production line starting in 2024, which will cover 50% of the needs of Ukrainian NPPs; the project will take 3 years²³³.

PM_ES_WAM_03 Establishment of fuel cassette production facilities to meet all needs of Ukrainian NPPs

Objective: Increase own production capacity and share in meeting the needs of Ukrainian NPPs

Legal basis: ESU

Timeframe: 2025-2032

Responsible authorities/organizations: Ministry of Energy

Description: A project is planned to build a nuclear facility for the production of fuel assemblies for nuclear reactors at nuclear power plants, with a capacity to cover the needs of all Ukrainian nuclear power units. At least, Energoatom planned to bring its separate Atomenergomash unit to full capacity for the production of fuel cassettes to meet all the needs of Ukrainian NPPs by 2025²³⁴.

The Energy Strategy of Ukraine for the period up to 2050, among its strategic initiatives and tasks until 2032, also envisages the in-house production of nuclear fuel assemblies for NPPs.

PM_ES_WAM_04 Development of uranium production

Objective: Increase own production capacities and increase the share in meeting the needs of Ukrainian NPPs in uranium at the expense of natural resources and technological capacities

Legal basis: ESU, Concept of the State Targeted Economic Program for the Development of the Nuclear Power Industry for the Period up to 2026²³⁵, Draft State Targeted Economic Program for the Development of the Nuclear Power Industry for the Period up to 2028²³⁶

Timeframe: 2024-2028

²³² <https://www.energoatom.com.ua/setting-up-production.html>

²³³ <https://www.energoatom.com.ua/o-3011232.html>

²³⁴ <https://www.energoatom.com.ua/setting-up-production.html>

²³⁵ <https://zakon.rada.gov.ua/laws/show/1804-2021-%D1%80#Text>

²³⁶ <https://mev.gov.ua/proyekt-normatyvno-pravovoho-aktu/povidomleniya-pro-oprylyudnennya-proyektu-rozporyadzhennya-0>

Responsible authorities: Ministry of Energy

Description: The development of nuclear energy in Ukraine will require an increase in uranium ore production and processing efficiency, given the availability of significant proven reserves and prospective resources, and the proven efficient mining and processing technology.

The State Targeted Economic Program for the Development of the Nuclear Industry for the period up to 2028 provides for support to VostGOK, the only enterprise that extracts and processes uranium ore in Ukraine, covering up to 40% of the demand. As a result of the Program implementation, it is expected that:

- to fully meet the needs of the national nuclear power industry 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;
- maintain the existing uranium ore mining and processing facilities;
- Increase the volume of uranium ore mining required to fully meet the needs of domestic nuclear power plants;
- Maintain uranium production, taking into account the decommissioning of the Vatutinskoye uranium ore deposit;
- to preserve and create new jobs despite the decommissioning of the Smolinskaya mine at the Vatutinskoye uranium ore deposit in 2024;
- maintain the volume of revenues to the State Budget of Ukraine and local budgets at all levels;
- to reduce the negative impact of uranium production on radiation safety and the environment.

The program envisages financing of measures in the amount of UAH 4.675 billion from the state budget, with targets to produce 683 tons of natural uranium concentrate in 2028, which will be approximately 30% of current needs. At the initial stage, it is expected that uranium raw materials will be transferred to foreign nuclear fuel producers for domestic nuclear power plants.

The Energy Strategy of Ukraine until 2050 actually repeats the provisions of the Concept and the draft Program, offering strategic initiatives and tasks among its strategic objectives:

- by 2025:
 - Maintaining the plant's existing uranium ore mining facilities;
 - Implementation of the state investment project "Novokonstantinovskaya mine. Development of production facilities";
 - Development of new uranium deposits;
- by 2032:
 - Increasing uranium production and reducing production costs;
 - Improving the efficiency of uranium ore processing and uranium production.

PM_ES_WEM_03 Creating gas reserves (filling gas storage facilities)

Objective: To ensure the security of natural gas supply in Ukraine

Legal basis: Law of Ukraine "On the Natural Gas Market", Law of Ukraine No. 2850-IX dated 13.12.2022 "On Amendments to Certain Legislative Acts of Ukraine on Certification of the Gas Storage Operator and Continuation of Measures to Prevent Bankruptcy of the State Joint Stock Company Chornomornaftogaz"²³⁷

Responsible authorities/organizations: Ministry of Energy

Description: The Law "On the Natural Gas Market" provides for the possibility of establishing an obligation for all suppliers to form a reserve stock of natural gas in the amount of no more than 10% of the planned monthly supply to consumers for the next month. The amount of the reserve stock is set annually by the Cabinet of Ministers at the same level for all suppliers.

However, in recent years, this level has been zero, and the universal obligation itself has been difficult to fulfill due to the projected financial burden on market participants and the administrative burden on public authorities. The 3% safety margin level proposed by the Ministry of Energy in 2023²³⁸ assumed that the costs associated with meeting the requirements would amount to UAH 848.5 million in the first 3-6 months.

Adopted in 2022, Law No. 2850-IX, which, among other things, implements Articles 6a and 6c of Regulation (EU) 2017/1938, defines the target level of filling of gas storage facilities as "the mandatory level of filling of underground gas storage facilities as of the relevant date, set as a percentage of the total capacity of underground gas storage facilities, which is specified in the schedule of filling of gas storage facilities". The Ministry of Energy is responsible for developing the schedule, and monthly reports are submitted by the gas storage operator to the Ministry of Energy and the Regulator in accordance with the procedure provided for in the Rules on Security of Natural Gas Supply.

At the same time, the regulatory framework needs to be improved to fully implement the requirements of Regulation (EU) 2017/1938 (see PM_ES_WAM_06 Implementation of EU rules on security of electricity and gas supply). This applies to both amendments to the Law on the Natural Gas Market in terms of mechanisms for targeting the level of gas storage capacity and the Rules on Security of Natural Gas Supply to include clear rules for calculating the target level of gas storage capacity and scheduling the filling of gas storage facilities. In 2023, the Ministry of Energy published a draft order on amendments to the Rules²³⁹

The Action Plan for the preparation of housing and communal services and the fuel and energy complex of Ukraine for the autumn-winter period of 2023/24 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, 2023²⁴⁰. A separate decision of the Energy Community Secretariat²⁴¹ approved the targets (including interim indicative targets) for the period until November 2024, submitted by Ukraine in accordance with the requirements of the law.

At the same time, according to Ukrtransgaz JSC²⁴², with an annual gas consumption of up to 35 billion cubic meters, to ensure reliable gas supply to Ukrainian consumers to compensate for seasonal and daily fluctuations, it is enough to fill UGS facilities at the level of 47.5-55% (19.3-21.7 billion cubic meters of active gas). To ensure reliable supply in winter (February-March), active gas reserves in UGS facilities should be formed in such a way as to ensure daily withdrawal of 133 million cubic meters with an active

²³⁷ <https://zakon.rada.gov.ua/laws/show/2850-20#Text>

²³⁸ <https://mev.gov.ua/rehulyatornyy-akt/povidomleniya-pro-oprylyudneniya-do-proektu-postanovly-kabinetu-ministriv-ukrayiny>

²³⁹ <https://mev.gov.ua/rehulyatornyy-akt/povidomleniya-pro-oprylyudneniya-proektu-nakazu-ministerstva-enerhetyky-3>

²⁴⁰ <https://www.naftogaz.com/news/naftogaz-group-fulfilled-the-plan-of-the-cabinet-of-ministers-of-ukraine>

²⁴¹ <https://www.energy-community.org/news/Energy-Community-News/2023/11/15.html>

²⁴²

<https://utg.ua/img/menu/company/docs/2021/%D0%9F%D0%BB%D0%B0%D0%BD%D0%9F%D0%A1%D0%93%202021-2030.pdf>

gas volume of about 13 billion cubic meters, as well as develop and implement technical measures to increase the daily capacity of gas storage facilities.

PM_ES_WEM_04 Creation of coal and reserve fuel (fuel oil) stocks

Objective: Ensuring the security of electricity supply

Legal basis: *The Procedure for Formation of the Forecast Electricity Balance of the Integrated Power System of Ukraine for the Settlement Year²⁴³ , the Rules on Security of Electricity Supply²⁴⁴ , the Government's decision in preparation for the autumn and winter periods²⁴⁵*

Responsible authorities/organizations: Cabinet of Ministers of Ukraine, Ministry of Energy, market participants

Description: The formation and maintenance of fossil energy reserves for generating facilities (natural gas, coal, fuel oil) is carried out as a measure within the Government's activities to coordinate the industry's preparation for each WEO. As a rule, the targets are set in the form of CMU orders²⁴⁶ .

However, the basis is the forecast electricity balance of the IPS of Ukraine for the billing year, which is prepared by the TSO and approved by the Ministry of Energy. In accordance with the Rules on Security of Electricity Supply, to ensure security of supply in the short term, the Ministry of Energy approves the Forecast Electricity Balance of the IPS of Ukraine, as well as the type and amount of fuel reserves for certain types of power plants (no later than December 1 of the year preceding the forecast year). Security of supply is monitored, inter alia, with regard to the schedule and volumes of supply and accumulation (reserves) of all types of fuel within the forecast balances of electricity production.

According to a separate Procedure, calculations of the baseline and marginal balance sheet options should take into account assumptions about the volume of own extraction (production) of fuel and its refined products, their forecast prices, and the risk of insufficient fuel supply to generating facilities.

The volume of fuel supply should be taken into account when determining the volume of fuel supply:

- for thermal power plants:
 - creation of guaranteed coal reserves corresponding to 10- or 20-day consumption volumes, depending on the remoteness of the coal mining site;
 - preventing the reserve fuel (fuel oil) stocks from falling below the 10-day volume required to ensure unit start-ups and the necessary lighting;
- for thermal power plants:
 - formation of guaranteed coal reserves corresponding to the 20-day average daily consumption required to meet the heat load schedule in accordance with the concluded heat supply contracts in the forecast month (at TPPs for which coal is the main fuel);
 - preventing the reserve fuel (fuel oil) stock from falling below the 10-day volumes required for unit start-ups and necessary lighting (at TPPs where coal is the main fuel);
 - preventing the reduction of a 10-day reserve fuel (fuel oil) stock to ensure the survivability of CHPs and heating networks in the event of a complete cessation of natural gas supply (at CHPs for which natural gas is the main fuel).

²⁴³ <https://zakon.rada.gov.ua/laws/show/z1312-18#Text>

²⁴⁴ <https://zakon.rada.gov.ua/laws/show/z1076-18#n17>

²⁴⁵ <https://zakon.rada.gov.ua/laws/show/515-2023-%D0%BF#Text>

²⁴⁶ See, e.g., <https://zakon.rada.gov.ua/laws/show/586-2021-%D1%80#Text>.

After approval of the forecast balance, electricity producers at TPPs and CHPPs provide the Ministry of Energy with data on the forecast fuel structure. When developing such forecasts, TPPs are obliged to ensure that:

- supplying coal in the amount of planned expenses in accordance with the approved forecast electricity balance;
- formation of guaranteed coal reserves corresponding to 10 days (for G+D) or 20 days (for ASh+P) of average daily coal consumption (based on consumption data for the last three years and a weighting factor depending on the month).
- creating a 10-day supply of reserve fuel (fuel oil) at TPPs that use coal as their main fuel for unit start-ups and possible backup.

In turn, electricity producers at CHPPs are obliged to ensure the formation of guaranteed reserves of coal and reserve fuel (fuel oil) at a level similar to that used to determine the volume of fuel supply.

Based on the information received from the generating companies, the Ministry of Energy draws up a consolidated forecast fuel structure for TPPs and CHPPs, and develops and approves a schedule for accumulating coal and reserve fuel (fuel oil) at the end of each month of the billing year for TPPs and CHPPs. Electricity producers at TPPs and CHPs also monitor the implementation of the approved schedule and, in case of a decrease, inform the Ministry of Energy and TSO of the reasons and measures to bring fuel stocks in warehouses in line with the schedule. The Ministry of Energy and the TSO also monitor the indicators of the forecast electricity balance, including fuel reserves, independently.

Reduction of guaranteed coal reserves is allowed in case of force majeure in coal supply, as well as with the approval 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 restored within 20 days from the last day of the month when the decrease in these volumes began.

PM_ES_WAM_05 Establishment of minimum oil and petroleum products stocks (MOP)

Objective: Ensuring continuous supply of oil and oil products to the domestic market of Ukraine in the event of a crisis situation on the oil and oil products market by implementing the requirements of Council Directive 2009/119/EC, which provides for the establishment of a minimum stock level equal to 90 days of average daily net imports or 61 days of average daily consumption, whichever is higher.

Legal basis: Law on Minimum Stocks of Oil and Oil Products²⁴⁷ (adopted on November 21, 2023)

Timeframe: Phased in, with the target volume being achieved within 8 years of its entry into force (12 months after the date of entry into force); approximately by 2032-2033. At the same time, market participants are obliged to create minimum oil reserves from the MORR 6 months after the date of termination or lifting of martial law.

Responsible authorities/organizations: Cabinet of Ministers of Ukraine, Ministry of Energy, State Customs Service of Ukraine, State Tax Service of Ukraine, State Statistics Service of Ukraine

Description: Ukraine has not yet created the MZNN, which, along with the complete destruction of the oil refining industry as a result of the full-scale invasion of Ukraine by the Russian Federation, creates a risk of interruptions in the supply of oil products. In the event of a cessation of oil and petroleum products supplies, the country will be able to meet its needs for no more than 10-30 days at the expense of its own production and existing reserves²⁴⁸.

²⁴⁷ <https://zakon.rada.gov.ua/laws/show/3484-IX#Text>

²⁴⁸ <https://itd.rada.gov.ua/billInfo/Bills/pubFile/1853886>

The adopted Law defines the basic principles of creation and functioning of the IHL system in Ukraine, as well as regulates relations in this area (functions and powers of state controlling bodies, administrator of the reporting system). The Act defines the concept of a crisis situation in the oil and oil products market, its levels, the procedure for creating, storing, replacing the MSDS, as well as disclosing it in the event of a crisis, and the procedure for financing the functioning of the MSDS.

The military risks of creating the UOG are mitigated by the provision that during martial law, part of the reserves may be stored abroad in EU member states bordering Ukraine (no more than 50% of the total) and EU countries bordering such states (no more than 25% of the total). The Energy Strategy of Ukraine for the period up to 2050 envisages the construction of protected storage facilities for oil reserves among its strategic initiatives and tasks by 2025.

The established MOFCOMs can only be used in crisis situations related to supply disruptions and fuel shortages and cannot be used as a tool to regulate market prices. The law provides for liability for violation of the rules and conditions for storing stocks.

In addition, Ukrtransnafta JSC is planned to be involved in the implementation of the requirements for the storage of oil and oil products²⁴⁹. In particular, it is assumed that the operator of oil and oil product pipelines will act as a responsible custodian, while other companies will be the owners. In order to implement this project, Ukrtransnafta will have to take additional measures to increase its tank farm, given that the requirements of Council Directive 2009/119/EC prohibit storage in pipelines (similarly, the Law contains a restrictive definition of tanks).

PM_ES_WEM_05 Implementation of the first standard of conduct for gas infrastructure facilities (Standard N-1), standards of conduct for gas suppliers

Objective: Ensuring the security of natural gas supply in Ukraine by forecasting and assessing possible risks, taking measures to prevent, eliminate or reduce damage from crises. Identification of protected consumers and mandatory measures for market participants.

Legal basis: Law on the Natural Gas Market, Rules on Security of Natural Gas Supply²⁵⁰, National Action Plan²⁵¹

Responsible authorities/organizations: Ministry of Energy

Description: Standard N-1 stipulates 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 (a day when there is extremely high demand, the statistical probability of which is once in 20 years). The Ministry of Energy is responsible for the annual calculation of the N-1 standard.

In addition, all natural gas suppliers are required to take measures to ensure sufficient gas resources for the needs of their protected consumers. These measures include maintaining stocks in gas storage facilities, entering into purchase and sale agreements for additional volumes, and limiting or terminating supplies to non-protected consumers. The relevant standards of behavior should be followed in the following cases:

- extreme temperatures during a 7-day peak period with a statistical probability of occurrence of once every 20 years (Standard 1);
- a period of unusually high demand for natural gas lasting 30 days or more, with a statistical probability of occurrence of once every 20 years (Standard 2);

²⁴⁹ <https://itd.rada.gov.ua/billInfo/Bills/Card/42196>

²⁵⁰ <https://zakon.rada.gov.ua/laws/show/z1489-15>

²⁵¹ <https://zakon.rada.gov.ua/laws/show/z1458-15>

- failure of the main gas pipeline under normal winter conditions for a period of 30 days (Standard 3).

The rules on security of natural gas supply are regularly reviewed. The next update should take into account the measures necessary to meet the gas supply standard in all scenarios specified in Article 6(1) of Regulation (EU) 2017/1938.

The Ministry of Energy is also responsible for the development and implementation of the National Action Plan, which defines measures to respond to different levels of crisis situations, as well as for organizing and conducting security of supply 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 this revision is also carried out thanks to the cooperation of the Ministry of Energy with the European Commission's Joint Research Center.

PM_ES_WEM_06 Meeting the minimum security criteria for electricity supply

Objective: To define measures to ensure the security of electricity supply (both preventive and in case of violations), minimum criteria for the security of electricity supply, and mandatory measures for market participants.

Legal basis: Law "On the Electricity Market", Rules on Security of Electricity Supply²⁵²

Responsible authorities/organizations: The Ministry of Energy, with the participation of the Regulator and the TSO (PrJSC NPC Ukrenergo)

Description: Most of the threats and measures to prevent/respond to them are in the field of view of the TSO, which monitors compliance with the operational security of supply standards (defined by the Transmission System Code²⁵³). The Ministry of Energy is responsible for organizing and conducting security of supply monitoring (jointly with the Regulator, the transmission system operator and other relevant institutions). A report on the results of the security of supply monitoring should be published every two years.

PM_ES_WAM_06 Implementation of EU rules on security of electricity and gas supply

Objective: To ensure the security of electricity and natural gas supply through risk assessment and preparation of action plans

Legal basis: EU law

Responsible authorities/organizations: Ministry of Energy/Regulator, with the participation of TSOs, DSOs, ENTSO-E, Regional Coordination Centers (RCCs) and other parties

Description: Ukraine needs to implement the requirements of EU legislation, in particular Regulation (EU) 2019/941 on risk preparedness in the electricity sector and repealing Directive 2005/89/EC, Regulation (EU) 2019/943 on the internal market in electricity (as regards the implementation of the electricity supply standard), and Regulation (EU) 2017/1938 on measures to guarantee security of gas supply and repealing Regulation (EU) No 994/2010 (except for the part on filling gas storage facilities).

Regulation (EU) 2019/941 requires the designation of an authorized body to carry out an electricity supply risk assessment, taking into account the regional risk assessment (carried out by ENTSO-E), to prepare and approve a Risk Preparedness Plan (listing the measures planned or taken to prevent, prepare and mitigate

²⁵² <https://zakon.rada.gov.ua/laws/show/z1076-18>

²⁵³ <https://zakon.rada.gov.ua/laws/show/v0309874-18>

crises). This plan should be prepared in accordance with Articles 11 and 12 of the Regulation and the template set out in the Annex to the Regulation, with the participation of all relevant stakeholders.

Regulation (EU) 2019/943 requires the assessment of resource adequacy at the national level, taking into account the results and parameters of the EU resource adequacy assessment (carried out by ENTSO-E). The Regulation also provides for the possibility of applying capacity provision mechanisms. The methodology for assessing the adequacy of resources takes into account such components as the calculation of the value of lost load (VoLL), the calculation of the cost of entry of a new participant (CoNE), and the definition of the Reliability Standard.

Regulation (EU) 2017/1938 requires the designation of an authorized body to carry out a regionally coordinated gas supply risk assessment, prepare and approve Preventive Action Plan and Emergency Plan. 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 relevant stakeholders. The implementation of the N-1 standard and the infrastructure standard is reinforced by solidarity and cooperation measures at the regional level. In 2023, the Ministry of Energy published a draft order²⁵⁴ on approving amendments to the Rules on Security of Natural Gas Supply in terms of conducting risk assessments in the form and requirements of the Regulation.

PM_ES_WEM_07 Establishment of a national system for the protection of critical infrastructure in the energy sector

Objective: Establishment and operation of a national system for the protection of critical infrastructure in the energy sector

Legal basis: Energy Security Strategy, the Law "On Critical Infrastructure"²⁵⁵ and bylaws, the Energy Strategy of Ukraine until 2050, the National Plan for the Protection and Ensuring the Security and Resilience of Critical Infrastructure²⁵⁶ and individual NSDC decisions

Timeframe: 2023-2024 (main activities of the National Plan for the Protection and Ensuring the Security and Resilience of Critical Infrastructure)

Responsible authorities/organizations: State Service for Special Communications and Information Protection of Ukraine (SSSCIP), Ministry of Energy, Ministry of Infrastructure

Description: The Energy Security Strategy identifies among the priority tasks for achieving Strategic Objective 2. Sustainability of the energy sector:

- introducing a system for conducting risk assessments and exchanging information on risks and threats to critical infrastructure in the energy sector;
- creating a system for preventing threats of any type and responding to crises, and implementing a plan for Ukraine's energy sustainability;
- introduce a mechanism for cooperation and interaction between the state and operators of critical infrastructure in the energy sector in case of crisis, including the involvement of state representatives in the participation and control of the implementation of crisis response plans.
 - The crisis situation itself is defined as follows: "a violation or threat of violation of the normal operation of the energy sector or critical infrastructure of the energy sector, which may result in the termination of energy supply to consumers in two or more regions of

²⁵⁴ <https://mev.gov.ua/rehulyatornyy-akt/povidomlennya-pro-oprylyudnennya-proektu-nakazu-ministerstva-enerhetyky-3>

²⁵⁵ <https://zakon.rada.gov.ua/laws/show/1882-20#n132>

²⁵⁶ <https://zakon.rada.gov.ua/laws/show/825-2023-%D1%80#Text>

Ukraine, or a reduction in the level of energy supply to consumers by more than 40 percent, the elimination and restoration of the normal operation of which requires special (emergency) measures."

At the same time, the Law "On Critical Infrastructure" is the basis for implementing the CIP protection policy. According to the State Service for Special Communications²⁵⁷, as the authorized body in the field of critical infrastructure protection in Ukraine, the operators of CIP are directly responsible for protecting CIP. The system operates in four modes: normal, preparedness and prevention of threats, response to a crisis situation, and restoration of normal operation.

The authorized body coordinates the activities of the subjects of the national protection system, ensures the formation and implementation of the state policy in the field of critical infrastructure protection. Formation and implementation of state policy in certain sectors are carried out by functional and sectoral bodies. Functional bodies (SES, National Police, SSU, etc.) are involved in responding to crisis situations related to ensuring the security and resilience of critical infrastructure.

The relevant sectoral authorities in the field of critical infrastructure protection²⁵⁸ include the Ministry of Energy (fuel and energy sector) and the Ministry of Community, Territorial and Infrastructure Development of Ukraine (utilities, including heat and hot water supply).

Among the important powers, it is the sectoral authorities that develop and approve requirements for the protection of CIP, projected threats to critical infrastructure at the sectoral level, rules and regulations for the protection of critical infrastructure in the relevant sectors, compile and maintain sectoral lists of CIP, categorize CIP together with operators, submit proposals for the inclusion of CIP in the national Register²⁵⁹, approve the safety passport for each CIP, decide on the announcement of modes of operation of critical infrastructure, carry out

The system should operate in four modes: normal, preparedness and prevention of threats, response to a crisis, and restoration of normal operation. At the same time, the CIP protection system is expected to be deployed by the end of 2024 in accordance with the main measures of the National Plan for the Protection and Ensuring the 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, CIP recovery plans, etc.) is scheduled for the second quarter of 2024.

While the system is not fully operational, in the context of military operations, the organization of protection and security of the functioning of the CFC in the energy sector of Ukraine is also coordinated by the NSDC.

PM_ES_WEM_08 Experiment on construction, repair and other engineering and technical measures to protect the ESC

Objective: To create a multi-level engineering and technical protection of key critical infrastructure facilities in the fuel and energy sector

Legal basis: CMU Resolution No. 1482 of December 27, 2022 "On the Implementation of a Pilot Project for the Construction, Repair and Other Engineering and Technical Measures to Protect Critical Infrastructure Facilities of the Fuel and Energy Sector of Critical Infrastructure"²⁶⁰

²⁵⁷ <https://cip.gov.ua/ua/news/ukrayina-pochinaye-buduvati-sistemu-zakhistu-kritichnoyi-infrastrukturi-vidpovidno-do-naikrashikh-svitovikh-praktik-ta-chinnikh-vimog-yevropeiskogo-zakonodavstva>

²⁵⁸ <https://zakon.rada.gov.ua/laws/show/1109-2020-%D0%BF>

²⁵⁹ <https://zakon.rada.gov.ua/laws/show/415-2023-%D0%BF#n15>

²⁶⁰ <https://zakon.rada.gov.ua/laws/show/1482-2022-%D0%BF#Text>

Timeframe: 2023-2024.

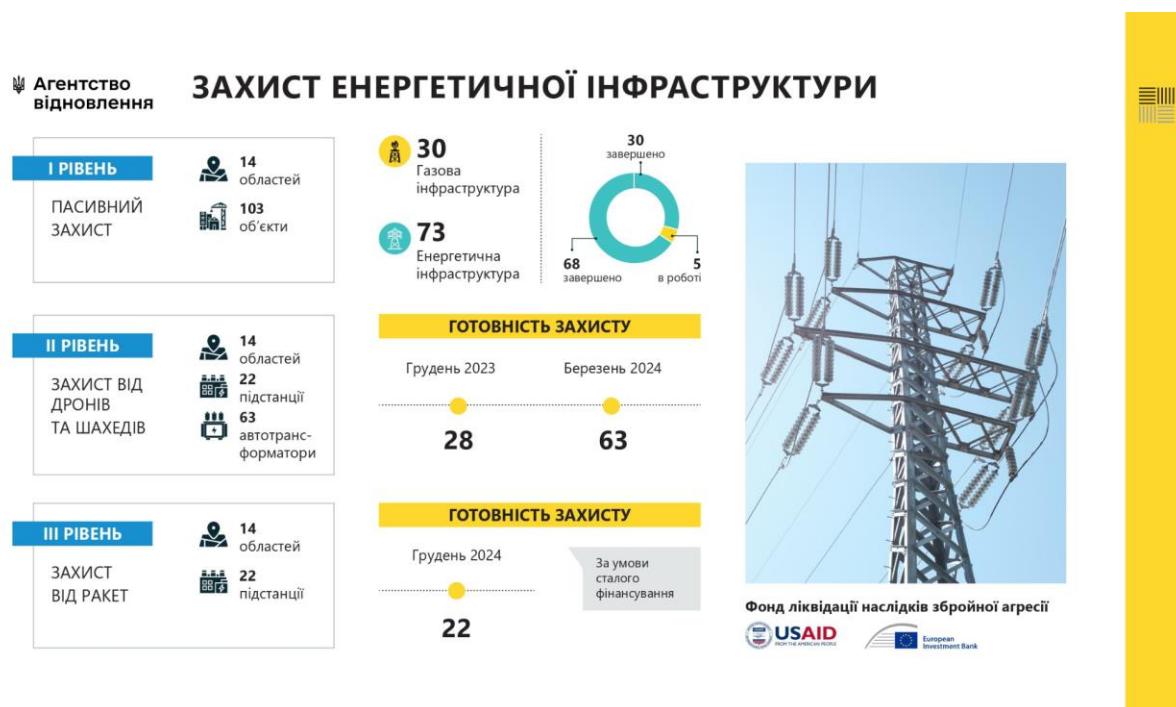
Responsible authorities/organizations: Ministry of Infrastructure, State Agency for Reconstruction and Development of Infrastructure (Reconstruction Agency)

Description: The project is coordinated by the Ministry of Infrastructure and the Recovery Agency, with participants including the Ministry of Energy, the General Staff of the Armed Forces of Ukraine, the State Emergency Service, critical infrastructure operators, the State Special Communications Service, regional and Kyiv city military administrations, the Recovery Agency, regional infrastructure recovery and development services, design and construction organizations (by agreement).

As part of the pilot project, by the end of the 2023/2024 winter heating season, two levels of protection - against attack UAVs and missiles - were to be installed at 22 main substations of the IPS of Ukraine²⁶¹. The Restoration Agency works together with NPC Ukrrenergo, which forms the design and construction tasks.

As of December 2023, the following progress in creating three levels of protection is known²⁶²:

- 1) passive shrapnel protection (gabions and big bags), 103 objects (73 electric power infrastructure, 30 gas infrastructure) are to be protected²⁶³ in 21 regions;
- 2) protection of autotransformers from shrapnel and drone strikes (reinforced concrete structures); 28 facilities have been completed; a total of 63 autotransformers of 22 substations in 14 regions are to be protected²⁶⁴, the main network will be completed by March 2024;
- 3) experimental protection against missile strikes (reinforced concrete structures); solutions were designed and computer modeling of loads was performed; a total of 22 substations in 14 regions are to be protected.



²⁶¹ <https://focus.ua/uk/economics/599528-do-kincya-zimi-u-mininfrastrukturi-nazvali-termini-vstanovlennya-zahistu-na-klyuchovi-pidstanciyi-video>

²⁶² <https://restoration.gov.ua/press/news/58489.html>, <https://mtu.gov.ua/news/35069.html>

²⁶³ <https://interfax.com.ua/news/economic/953814.html>

²⁶⁴ <https://mtu.gov.ua/news/35002.html>

Source: Ministry of Communities, Territories and Infrastructure Development of Ukraine

PM_ES_WAM_07 Ensure physical, engineering and cyber security of 100% of C&I facilities in the energy sector

Objective: The Energy Security Strategy identifies among the priority tasks for achieving Strategic Objective 2. Sustainability of the energy sector, among other things, ensuring cybersecurity and physical security of the critical infrastructure of the energy sector. The Cybersecurity Strategy of Ukraine²⁶⁵ lists the principles of building a national cybersecurity system as the acquisition of cyber resilience - the ability to quickly adapt to internal and external threats in cyberspace, maintain and restore the sustainable functioning of the national information infrastructure, especially critical information infrastructure. As of the end of 2023, the indicators for the implementation of the Cybersecurity Strategy are still under development.

Legal basis: ESU, Energy Security Strategy, Cybersecurity Strategy of Ukraine, Law "On the Basic Principles of Ensuring Cybersecurity of Ukraine", certain decisions of the NSDC

Responsible authorities/organizations: The State Service for Special Communications, the Ministry of Energy, the Ministry of Infrastructure, the National Coordination Center for Cybersecurity (NSDC), the Governmental Computer Emergency Response Team of Ukraine CERT-UA, etc.

Description: The ESA provides for strategic initiatives and tasks:

- by 2025:
 - Implementation of an integrated approach to security (physical security, engineering security and cyber security);
 - Development and approval of an effective methodology for assessing threats and the state of energy security that would meet the challenges of reliability and security of energy supply;
 - Approval of the location of new energy facilities (large assets of state-owned companies) with representatives of the security and defense sector and identification of the responsible state body;
 - Strengthening the ability to timely detect, prevent and neutralize threats to the security of energy infrastructure;
 - Developing a program for the comprehensive protection of energy infrastructure facilities, including a safety data sheet;
 - Implementation of comprehensive protection measures in the energy sector;
 - Improvement of engineering, technical and other measures to prevent and/or deter unlawful actions at energy IECs;
 - Ensure revision of the standards for providing the CMI with an emergency reserve of necessary equipment and facilities;
 - Revision of the project threat to nuclear facilities and other critical infrastructure, taking into account the results of the full-scale invasion of Ukraine by the Russian Federation;
 - Develop a program to strengthen security measures at existing energy infrastructure facilities;

²⁶⁵ <https://zakon.rada.gov.ua/laws/show/447/2021#n12>

- Ensuring the development of projects for the development of the transmission system and gas networks, taking into account all physical security requirements;
 - Determination of the responsible body for engineering safety and distribution of powers to implement engineering safety measures;
 - Studying the feasibility and implementation of pilot projects for the placement of certain elements of the energy infrastructure underground, taking into account the feasibility and possibility of placement (for example, substations in a protected design).
- by 2032:
- Developing a cost-effective proposal to change the state standards for the construction of new energy facilities, taking into account the need to adapt to climate change and minimize its impact, which will include amendments to regulations on the design, construction of electrical installations, and electrical networks to ensure their physical protection;
 - Implementation of integrated processes and modern technological solutions to improve the protection of energy sector systems from cyberattacks;
 - Stimulating investments in digitalization and cybersecurity in the energy sector;
 - Implementation of measures to implement the Concept for the Implementation of Smart Grids in Ukraine by 2035: determination of an index, indicators and methodology for assessing the state of cybersecurity of power grids in Ukraine in accordance with international practices, including the use of the Cybersecurity capability maturity model program.
 - Application of cybersecurity solutions to the infrastructure of information and computer systems, power grids, electricity metering systems and communication networks.
 - Ensure regular assessment of the state of cybersecurity of power grids in Ukraine.

The NSDC decision of October 17, 2023²⁶⁶ assigned the Cabinet of Ministers of Ukraine the task of guaranteeing the implementation of engineering and physical protection of critical infrastructure and the fuel and energy complex, approving the Action Plan for the restoration of critical infrastructure destroyed or damaged as a result of Russian aggression, and developing and approving the Energy Sustainability Plan of Ukraine in 2023 with the identification of funding sources. In turn, the Ministry of Energy, together with the Ministry of Infrastructure, the State Emergency Service, critical infrastructure operators, and military administrations, should ensure engineering protection of critical infrastructure facilities and their restoration in case of damage.

The responsibility for ensuring cybersecurity of CFCs' communication and technological systems, protection of technological information in accordance with the requirements of the law, for promptly informing CERT-UA of cybersecurity incidents, and for organizing an independent audit of information security at such facilities lies with the owners and/or managers of enterprises, institutions and organizations classified as CFCs.

The State Service for Special Communications coordinates, organizes and conducts vulnerability audits of communication and technological systems of critical infrastructure facilities. The SSU prevents, detects, stops and solves criminal offenses in cyberspace, and as part of the fight against cyberterrorism and cyberespionage, covertly checks the preparedness of CI for possible cyberattacks and cyberincidents.

To a large extent, the cybersecurity of critical infrastructure is related to the implementation of the requirements of the Law on Critical Infrastructure (see PM_ES_WEM_08). In particular, in December

²⁶⁶ <https://www.president.gov.ua/documents/6952023-48641>

2022, the Ministry of Energy approved the Cybersecurity Requirements for the Fuel and Energy Sector of Critical Infrastructure²⁶⁷.

The Ministry of Energy is working to build a sectoral cyber defense system for fuel and energy companies. The system is based on the concentration of efforts of two sectoral cyber centers established on the basis of Ukrenergo and Naftogaz of Ukraine. It is envisaged that the respective cyber centers will become sectoral cybersecurity centers for the electricity and oil and gas complexes, respectively, and in the future also for the nuclear-industrial, coal-industrial, and peat-extracting complexes²⁶⁸. In addition, at the working level, it was planned to develop a sectoral cybersecurity strategy for the energy sector's critical control points and to audit the state of cybersecurity at such control points²⁶⁹.

Thus, the creation of a multi-level cybersecurity system involves a) the direct responsibility of the ICC operators, b) the monitoring and expert role of sectoral cyber centers under the leadership of the Ministry of Energy, and c) the activities of the national cybersecurity system (State Special Communications Service, SSU, etc.). According to the ESU, it is also planned to create a Situation Center in the energy sector, which will allow forecasting events in the industry and increase the efficiency of decision-making through the functionality of simulating various scenarios.

PM_ES_WAM_08 Creation of backup power sources for the I&C facilities, including the use of distributed RES generation

Objective: To ensure the resilience of critical infrastructure to security threats and the continuity of vital services

Legal basis: *The Concept of the State Target Economic Program for Energy Modernization of State-owned or Communally Owned Heat Producers for the Period up to 2030*²⁷⁰; the draft Concept of the State Target Economic Program for Stimulating the Development of Distributed Electricity Generation from Renewable Energy Sources for the Period up to 2030²⁷¹; the draft updated version of the State Strategy for Regional Development for 2021-2027.²⁷²

Timeframe: 2023-2030.

Responsible authorities/organizations: Ministry of Energy, Ministry of Infrastructure, local governments

Description: The concept of the State Targeted Economic Program for Energy Modernization of Heat Producing Enterprises in State or Communal Ownership sets among its objectives the improvement of the efficiency and reliability of district heating systems. In turn, the implementation of the measures envisaged by the program will strengthen Ukraine's energy security and improve the safety and quality of heat supply services for 5.3 million households (see also PM_EE_WAM_08).

Incentive measures are envisaged in the form of support for local governments and heat supply companies through partial reimbursement of the cost of measures envisaged by the current heat supply scheme, including:

²⁶⁷ <https://zakon.rada.gov.ua/laws/show/z0249-23#Text>

²⁶⁸ <https://mev.gov.ua/storinka/kiberbezpeka-enerhetychnoyi-haluzi>

²⁶⁹

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

²⁷⁰ <https://zakon.rada.gov.ua/laws/show/1093-2023-%D1%80#Text>

²⁷¹ <https://mev.gov.ua/proyekt-normatyvno-pravovoho-aktu/povidomleniya-pro-oprylyudnennya-proyektu-roporyadzhennya-1>

²⁷² <https://mtu.gov.ua/news/35001.html>

- construction and connection to the district heating system of backup (in addition to the existing) heat sources and separate heat generating units using energy sources other than the main ones;
- installing backup power sources at heat supply facilities in district heating systems.

In turn, to take into account the challenges posed by the full-scale invasion of Ukraine by the Russian Federation in the affected regions and territories, 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 05, 2020, No. 695. One of the operational goals of the act is to develop sustainable, inclusive and resilient infrastructure, and the following related tasks are proposed for the Energy Infrastructure area:

- Ensuring the energy sustainability of territorial communities and regions by promoting the development of distributed electricity generation.
- Promoting the development of electricity generation from renewable sources and the use of energy storage facilities in centralized water supply and sewage systems.

Support for the deployment of sustainable decentralized sources of electricity is envisaged in the draft Concept of the State Target Economic Program for Stimulating the Development of Distributed Electricity Generation from Renewable Energy Sources for the Period up to 2030 (see PM_IME_WAM_05). In particular, it is envisaged that at the first stage (2024-2026), support will be provided to state-owned and municipal entities for RES installations with a capacity of up to 500 kW together with the EMI, which will ensure autonomous power supply to the CSPs for 4 hours²⁷³. Priority QFs include:

- centralized water supply systems (pumping stations 1 and 2, booster pumping stations);
- centralized wastewater disposal systems (sewage pumping stations, treatment facilities);
- district heating systems (boiler houses, central heating stations);
- healthcare facilities.

At the second stage (2027-2030), it is planned to extend support to other state and municipal facilities (administrative buildings, educational institutions, etc.) for RES installations with ESCs to cover basic needs (lighting, office equipment, communications).

It is worth noting that local governments, especially at the level of large cities, have already implemented or are planning to implement projects to equip vital infrastructure facilities (in particular, boiler houses, water utility pumping stations), as well as public buildings (healthcare facilities, educational institutions, and administrative buildings) with backup power sources. The technologies used include not only diesel generators, but also gas piston plants, solar panels and hybrid systems (a combination of different sources), often with energy storage facilities.

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.

Among other things, the Energy Security Strategy envisages the following priorities

- to achieve Strategic Objective 2 "Sustainability of the Energy Sector":
 - Ensuring a balanced development of energy supply systems, taking into account the uneven consumption and operation schedules of individual energy producers;
 - adaptation of the energy sector to the negative impact of climate change;

²⁷³ <https://mev.gov.ua/sites/default/files/file/prezentaciya.pdf>

- to achieve Strategic Goal 3 "Economic efficiency of the energy sector, energy supply systems and import substitution of mineral raw materials":
 - Renewal of fixed assets in the energy sector, in particular by creating favorable conditions for the introduction of mechanisms to support the implementation of large-scale investment projects for the development of critical infrastructure in the energy sector;
- to achieve Strategic Goal 4 "Energy efficiency of energy resources use and energy efficiency of the national economy":
 - implementing 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 IPS of Ukraine.

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 IPS of Ukraine, in particular in terms of the availability of regulating capacities."

The Energy Strategy of Ukraine until 2050 provides for greater clarity in setting targets for the development of highly maneuverable generation, EMS and demand-side management systems, and includes them among its strategic initiatives and tasks:

- by 2025:
 - Development of distributed generation using natural gas by installing gas turbines and gas piston turbines at the sites of the gas transmission system, CHP plants and boiler houses;
 - Development of renewable energy sources, which includes a set of measures for the construction of wind power plants, wind generation and promotion of distributed solar generation to cover own consumption;
 - Installation of wind farms/solar power plants and SPPs for critical infrastructure facilities and private households;
 - Active implementation of energy storage technologies with further expansion of their use in the following time horizons;
 - Studying the feasibility of creating microgrids and decentralized power supply to ensure the sustainability of the power system;
 - Study the feasibility of creating a demand management program.
- Until 2032:
 - Decentralization of the energy system by increasing the number of energy generation facilities while reducing spatial disproportions in their location, which will help to improve the overall reliability of energy systems and reduce their vulnerability to physical and virtual threats.
 - Implementation of pilot projects to create microgrids and decentralized power supply to ensure the resilience of the energy system.
 - Implementation of pilot projects to create a demand management program.
 - Support for the introduction of energy storage technologies.

Practical tools include

- **participation in the balancing market and the ancillary services market** on a general basis;
- **tenders for the construction of generating capacity and demand management measures;**

- provision of balancing and ancillary services **by aggregators and active consumers under the self-production 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 for and responding to natural gas or electricity supply crises provide for a mechanism for the constant exchange of information between Ukraine, on the one hand, and the Energy Community Secretariat (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 oil supply routes requires active cooperation between Ukraine and the states of Central and Eastern and Southeastern Europe, in particular Poland, Slovakia, Hungary, Romania, Bulgaria, and the Baltic states.

The Energy Community Secretariat and the governments of neighboring EU member states play a critical role in the mechanism of supplying equipment to the energy companies in Ukraine affected by the consequences of the hostilities. In particular, the Energy Community Secretariat, together with the European Commission, the EU Emergency Response Coordination Center and the Ukrainian authorities, ensures the delivery of energy and energy products, both free of charge and purchased with funds from the Energy Support Fund for Ukraine²⁷⁴; equipment procurement is carried out in accordance with international transparency standards by the United States Agency for International Development (USAID).

Ukraine's implementation of the EU's Clean Energy for All Europeans package of legislation envisages market unification and strengthening of mutual energy security based on the principle of solidarity. In particular, the Ukrainian TSO should use the opportunities of full membership in ENTSO-E and join the activities of the Regional Coordination Center (RCC) to participate in seasonal and short-term resource adequacy assessments. The implementation of Regulation (EU) 2019/941 on risk preparedness in the electricity sector and Regulation (EU) 2017/1938 on measures to ensure security of gas supply provides for 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 relevant plans (consultations to ensure consistency).

The integration of gas systems and markets with the participation of the GTS Operator of Ukraine, Ukrtransgaz and other market players is the subject of cooperation within the framework of 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's joint gas procurement platform AggregateEU.

Cooperation with the governments and operators of neighboring countries in the process of identifying and implementing projects of mutual interest (PMI) and projects of common interest within the Energy Community (ECI) is also promising. See more details in Section 3.4 "Internal Energy Market".

Regional cooperation is also envisaged when Ukraine creates minimum stocks of oil and oil products. The Law on MOPR contains a provision that during martial law, part of the reserves may be stored abroad in EU member states bordering Ukraine (no more than 50% of the total) and in EU countries bordering such states (no more than 25% of the total). Outside of martial law, no more than 25% of the total amount of stocks may be stored in EU member states bordering Ukraine if the central storage facility or economic entity has free reservoirs.

In May 2023, Ukraine officially joined NATO's Joint Cyber Defense Center of Excellence (CCDCOE), which provides cyberattack and cyber defense of information systems, as well as education and training of

²⁷⁴ <https://www.energy-community.org/Ukraine/Fund.html>

cyber defense specialists²⁷⁵. Ukraine's participation in the Center will enhance the exchange of cyber experience with other member states, in particular in the protection of critical infrastructure in the energy sector.

An important platform for political dialogue and technical cooperation on energy security is the Partnership for Transatlantic Energy and Climate Cooperation (P-TECC), which involves Ukraine, the US, the EU and 24 European countries²⁷⁶.

iii. If applicable, funding measures in this area at the national level, including Union support and use of Union funds

The vast majority of the required funding is made up of investments made by energy market players - extractive companies, TSOs and the GTS operator, DSOs and GDSOs, traders and suppliers (in particular, in terms of creating minimum oil and oil products reserves), operators of oil refineries, power generating companies, etc. At the same time, a form of state aid is the creation of favorable tax and regulatory conditions, in particular for companies in the extractive sector.

Funding from the state budget is still envisaged for the program of development of the nuclear industry (support for uranium production at VostGOK, totaling UAH 4.675 billion) and certain works of the pilot project for the construction, repair and other engineering and technical measures to protect key critical infrastructure facilities. At the same time, the implementation of a full range of measures to protect these facilities requires the involvement of funds from Ukraine's international partners, including technical assistance.

A significant amount of technical assistance, including for preparing bankable projects and improving the quality of public administration, can be obtained through participation in the EU programs Horizon Europe, Connecting Europe Facility (CEF), Digital Europe Program, and LIFE. A separate area will be funding opportunities under the Ukraine Facility program, which is designed for 2024-2027.

3.4 Internal Energy Market Dimension

3.4.1 Electricity infrastructure

i. Policies and measures to achieve the target level of integration of energy systems as defined in Article 4(d)

Planning the development of interconnectors. The development of interconnections 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. The TSDP shall ensure that the transmission system meets the needs of the market and the interests of security of electricity supply. The TSDP shall, in particular, contain:

- the main transmission system facilities, the construction or reconstruction of which is expedient over the next 10 years, including projects for the development of interstate crossings;
- information on the transmission system facilities to be built and/or reconstructed over the next 10 years, the terms of their construction and/or reconstruction, and sources of funding;

²⁷⁵ http://twitter.com/MFA_Ukraine/status/1658432462689652738

²⁷⁶ <https://www.energy.gov/ia/partnership-transatlantic-energy-and-climate-cooperation-p-tecc>

- information on investments in the transmission system facilities for which decisions have already been made and which are under implementation, indicating the forecast investments to be made over the next three years.

The TSO develops the IRP on the basis of the report on the assessment of the adequacy (sufficiency) of generating capacities, as well as plans for the development of adjacent transmission and distribution systems. The TSO also develops an appropriate investment program and submits it to the Regulator together with the calculation of the tariff for electricity transmission services.

Simplification of administrative procedures and attraction of investments in infrastructure projects of mutual interest is ensured through the implementation of the policy **PM_IM_WAM_01 Promotion of new interstate connections/intersections** (see paragraph 3.4.2.i).

ii. Regional cooperation in this area

In 2017, TSO Ukrenergo signed an Agreement on the conditions for the future integration of the Ukrainian power system with the power system of Continental Europe, which provided for the implementation of a catalog of measures to prepare and pass a test in the form of 3-day isolation from the power systems of the Russian Federation and the Republic of Belarus. Since March 16, 2022, the Integrated Power System (IPS) of Ukraine has been urgently integrated and operates in synchronous mode with the power system of Continental Europe within the European Network of Transmission System Operators for Electricity (ENTSO-E). During 2022-2023, the TSO of Ukraine completed the implementation of the Catalog of Measures, which is part of the Agreement on the Conditions for the Future Interconnection of the Power Systems of Ukraine and Continental Europe. The catalog contains more than 200 technical measures in 9 areas. All of these measures are an integral part of the Synchronous Area Framework Agreement for Continental Europe (SAFA), to which Ukrenergo also joins. On November 28, 2023, ENTSO-E Regional Group Continental Europe confirmed the full implementation of the Catalogue of Measures by Ukrenergo, which means the completion of the synchronization project between the Ukrainian power system and the European continental grid.²⁷⁷

Until December 2023, TSO Ukrenergo was an observer member of ENTSO-E and ensured the technical compliance of the IPS of Ukraine with the standards and requirements of ENTSO-E. On December 14, the ENTSO-E Assembly approved the acquisition by the Ukrainian TSO of the status of full membership in the organization from January 1, 2024.²⁷⁸ The ENTSO-E membership status provides the TSO with opportunities to deepen regional cooperation:

- in the preparation of proposals and approval of the ENTSO-E annual work program, which defines priorities for key issues of the electricity market, development of trans-European energy infrastructure, and energy risk management;
- when adopting the 10-year European Network Development Plan and the strategy for events that significantly affect the technical, security, market or financial conditions of the European TSOs;
- in preparing recommendations for the ENTSO-E Assembly on strategic priorities for TSO cooperation and key decisions;
- participate in the work of Committees and Working Groups (Committees on Market Issues, Network Development, Research, Development and Innovation, Information and Communication

²⁷⁷ <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/>

²⁷⁸ <https://www.entsoe.eu/news/2023/12/14/ukrainian-transmission-system-operator-npc-ukrenergo-joins-entso-e-as-new-member/>

Technologies), in the development of network codes, regional investment plans and work in the group on legal and regulatory issues.

The TSO of Ukraine carries out bilateral and multilateral communication and cooperation with the TSOs of neighboring countries in terms of increasing capacity and developing interconnections, taking into account the provisions of Regulation (EU) 347/2013 on guidelines for trans-European energy infrastructure (TEN-E).²⁷⁹ The TSO also organizes cooperation in accordance with the Ukrrenergo Stakeholder Engagement Plan within the framework of reconstruction/construction projects.²⁸⁰

In order to develop regional cooperation, the TSO of Ukraine will further cooperate with the TSOs of other countries in the region in the format of interaction with the regional coordination center (RCC) provided for by Regulation (EU) 2019/943 on the internal market in electricity. The interaction will be carried out within the framework of the functionality defined in Annex I to this Regulation,²⁸¹ in particular, in terms of creating a regional grid model, coordinated mode calculations and determining corrective actions in the region, determining the capacity of cross-border crossings for distribution, etc.

iii. If applicable, funding measures in this area at the national level, including Union support and use of Union funds

The revenues received by the TSO from auctions for the allocation of cross-border capacity are used to guarantee the availability of the allocated capacity, to maintain and increase capacity by investing in the transmission system, in particular in the construction of new cross-border transmission lines.²⁸²

To develop the transmission system and finance projects, the TSO cooperates with leading international financial institutions, including:

- World Bank;
- European Bank for Reconstruction and Development;
- European Investment Bank;
- KfW, the German Credit Institution for Reconstruction.

Loans are provided by international financial institutions (IFIs) under government guarantees for 15-20 years or more with low interest rates compared to lending terms of Ukrainian commercial banks and the cost of other financial instruments. The loan portfolio with IFIs amounts to about EUR 1.7 billion. The most large-scale investment projects are financed that ensure increased reliability of electricity supply to

²⁷⁹ <https://eur-lex.europa.eu/legal-content/en/TXT/?uri=celex%3A32013R0347>

²⁸⁰ https://ua.energy/wp-content/uploads/2023/08/Plan_vzayemodiyi_NEK.pdf

²⁸¹ <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A02019R0943-20220623#M1-1>

²⁸² Temporarily, in connection with the introduction of martial law in Ukraine, the funds received by the TSO from the distribution of cross-border transmission capacity, except for revenues from the management of restrictions, in the period from January 1, 2023 to December 31, 2023, shall be used for the following purposes 10% - to guarantee the actual availability of the allocated throughput, maintenance and increase of throughput by investing in the transmission system, repayment of debts under agreements on access to the throughput capacity of the interstate crossing; 45% - to repay the TSO's debt formed in the balancing market; 45% - to repay the TSO's debt to the guaranteed buyer for the services provided to ensure an increase in the share of electricity production from alternative sources.

industrial consumers and households, energy security of the state, development of the national economy, and have a social and environmental focus.²⁸³

It also envisages Ukraine's participation and attraction of funds for the implementation of projects for the development of interstate electricity infrastructure under the EU's Connecting Europe Facility program. The relevant agreement between Ukraine and the EU was ratified by the Verkhovna Rada of Ukraine in November 2023.²⁸⁴

3.4.2 Energy transmission infrastructure

i. Policies and measures related to the elements identified in paragraph 2.4.2, including specific measures to enable the implementation of projects of common interest (PCI) and other key infrastructure projects

PM_IM_WAM_01 Mechanisms for the development of new interstate connections/intersections

Objective: to facilitate the creation of new or increase the existing physical capacity of gas / electricity interconnectors, in particular at the expense of private investors, by establishing mechanisms to stimulate cross-border investment.

Legal basis: Regulation (EU) 2022/869 on guidelines for trans-European energy infrastructure, Regulation (EU) 2019/942 establishing the European Union Agency for the Cooperation of Energy Regulators, the Law of Ukraine "On the Natural Gas Market", the Law of Ukraine "On the Electricity Market"

Timeline: 2024-2025

Responsible authorities/organizations: Verkhovna Rada of Ukraine, Cabinet of Ministers of Ukraine, Ministry of Energy, NEURC

Description: Stimulating investment, including private investment, in new interconnectors for natural gas and international electricity crossings requires the establishment of mechanisms to support such investment that are in place in the EU. Such mechanisms are:

- Establish a coordinated transparent procedure for obtaining the necessary permits for the implementation of cross-border projects, empowering regulatory authorities to make decisions on cross-border cost sharing, as provided for by Regulation (EU) 2022/869 on guidelines for trans-European energy infrastructure (TEN-E);
- Establish a separate regulatory regime for the most necessary, but at the same time risky projects, as provided for in Article 54 of the Law of Ukraine "On the Natural Gas Market" and Article 24 of the Law of Ukraine "On the Electricity Market";
- Coordination of decision-making by the authorities of different states through the powers of the European Union Agency for the Cooperation of Energy Regulators (ACER), as provided for by Regulation (EU) 2019/942 establishing the European Union Agency for the Cooperation of Energy Regulators.

To implement the previous version of Regulation 2022/869, the draft Law of Ukraine No. 9138 "On Projects of National Interest in the Energy Sector" has been developed and is currently being considered by the

²⁸³ <https://ua.energy/yevrointegratsiya/spivrobitnytstvo-z-mfo/>

²⁸⁴ <https://itd.rada.gov.ua/billInfo/Bills/Card/43091>

Verkhovna Rada of Ukraine.²⁸⁵ This draft law provides for the introduction of a transparent procedure for the implementation of projects of national interest in the energy sector, in particular, determining the procedure and criteria for selecting projects; establishing an interagency commission to ensure project implementation; preparing a project implementation plan and a schedule for obtaining a comprehensive solution in order to meet project implementation deadlines (3.5 years); determining the possibility and procedure for cross-border distribution of investment costs for projects of common interest of the Energy Community between countries with the highest At the same time, this project needs to be harmonized with the latest version of Regulation 2022/869, as well as with the requirements for obtaining funding from the United Europe Facility, which has recently been opened to Ukraine.

Article 36 of Directive 2009/73/EC and Article 63 of Regulation (EU) 2019/943 provide for the possibility, based on a decision of the regulator, to create a separate regulatory regime (granting exceptions to the general regulatory regime) for operators of new cross-border infrastructure. These provisions have been implemented in Ukrainian legislation by Article 54 of the Law of Ukraine "On the Natural Gas Market" and Article 24 of the Law of Ukraine "On the Electricity Market". At the same time, the implementation of cross-border projects based on these provisions of Ukrainian legislation, given the need to create a single predictable legal regime in several countries, requires, first, verification of these provisions for full compliance with EU legislation and, second, development and adoption of additional regulations.

Regulation 2019/942 establishing ACER, implemented in the Energy Community, provides for the extension of ACER's mandate to cross-border issues involving at least one Energy Community Contracting Party and one EU Member State, which is important for the implementation of cross-border projects. A condition for the extension of ACER's powers is the implementation of Regulation 2019/942 and notification of the Energy Community Secretariat. The relevant ACER powers apply to both the electricity and natural gas markets. The draft law developed by the NEURC to implement this Regulation²⁸⁶ concerns only amendments to the Law of Ukraine "On the Electricity Market".

In 2025-2026, work should be done to bring Ukrainian legislation into full compliance with these EU requirements, with the possible involvement of international technical assistance and in consultation with EU institutions and potential investors.

PM_IM_WEM_01 Current procedures for planning energy infrastructure development

Objective: to develop energy infrastructure in line with the goals of the NEC and the principle of "energy efficiency first"

Legal basis: Law of Ukraine "On the Natural Gas Market", Law of Ukraine "On the Electricity Market", GTS Code

Timeframe: 2024-2030 (ongoing)

Responsible authorities/organizations: GFS, OSP, NCPCP

Description: The Law of Ukraine "On the Natural Gas Market" and the Law of Ukraine "On the Electricity Market" provide for the development of plans for the development of energy infrastructure facilities by the

²⁸⁵ <https://itd.rada.gov.ua/billInfo/Bills/Card/41623>

²⁸⁶ <https://www.nerc.gov.ua/news/oprilyudnyuyetsya-proyekt-zakonu-ukrayini-pro-vnesennya-zmin-do-deyakih-zakoniv-ukrayini-shchodo-transponuvannya-aktiv-energetichnogo-spivtovaristva>

GTSO, TSO, DSO, DSO and other operators of these facilities and their approval and monitoring by the Regulator. In addition, the TSO develops, and the Regulator approves, a report on the assessment of the adequacy (sufficiency) of generating capacities to cover the forecasted demand for electricity and ensure the necessary reserve.

The relevant plans are prepared annually by operators and approved by the NEURC.

In addition, in accordance with the GTS Code, immediately after the start of the annual capacity allocation auction in each odd-numbered year, the GTSOU cooperates with the relevant adjacent TSOs of other countries in the process of assessing market demand for capacity increase and conducting technical studies of new (increased) capacity projects for interconnection points. The first market demand assessment was carried out in 2021. The second market demand assessment was carried out in 2023.

PM_IM_WAM_02 Additional procedures for planning the development of energy infrastructure

Goal: to develop energy infrastructure in line with the goals of the NEC and the principle of "energy efficiency first"

Legal basis: clause 1, part 2, article 3 of the Law of Ukraine "On Energy Efficiency", amendments to Directive 2009/73/EC and Regulation 715/2009

Timeline: 2024-2030 (ongoing)

Responsible authorities/organizations: Verkhovna Rada of Ukraine, Cabinet of Ministers of Ukraine, NEURC, Ministry of Energy, Ministry of Infrastructure, GTSO, TSO

Description: In view of the latest draft amendments to Directive 2009/73/EC and Regulation (EC) 715/2009, which the EU is expected to adopt in 2024, measures should be taken to improve energy infrastructure planning procedures in the period 2024-2029:

- incorporation of the "energy efficiency first" principle, which is recognized by the ESU, into energy infrastructure planning procedures. According to this principle, plans to expand the physical capacity of natural gas should be consistent with this principle, which, in particular, provides for priority investments in energy efficiency and consumption reduction over the construction of new energy and energy resources delivery infrastructure. At the same time, the relevant risks to other goals of the NEC (including energy security) should be analyzed;
- creation of plans for the development of oil and oil products transportation infrastructure, as well as hydrogen, with some adaptation of the content and regulatory framework for approving such plans;
- integration of planning processes in the electricity, gas, oil, and hydrogen markets;
- Ensure coordination of energy infrastructure development plans with territory and community development plans, in particular, plans for the development of heat supply and recovery systems;
- Ensure that energy infrastructure development plans are linked (controlled and held accountable) to the ownership policies of the relevant state-owned companies.

PM_IMG_WAM_01 Establishing a legal and regulatory framework for the formation of future markets and building their infrastructure

Objective: to develop a regulatory framework sufficient for the development of hydrogen and carbon dioxide (CO₂) markets and infrastructure

Legal basis: ESU, draft Water Strategy of Ukraine for the period up to 2050

Timeframe: 2024-2025

Responsible authorities/organizations: Verkhovna Rada of Ukraine, Cabinet of Ministers of Ukraine, Ministry of Energy, NEURC

Description: The ESU and the draft Hydrogen Strategy of Ukraine for the period up to 2050 define the task of creating legal, economic and organizational framework for the functioning of hydrogen energy in Ukraine. Given the strategic course of integration with the EU, it is logical that this process should follow the practices at the level of the EU and EU member states with the most developed technologies and/or hydrogen and CO2 markets.

As of 2024, Ukraine has a legal framework in place:

- there is no definition of hydrogen, its possible compounds (LOHC) and its environmental characteristics (renewable, low-carbon), no definition of CO2 as a substance that can be transported by pipelines and stored in underground gas storage facilities;

The Law of Ukraine "On Alternative Fuels" contains a definition of "biohydrogen", which, however, does not cover hydrogen produced by electrolysis, which is expected to be the main method of hydrogen production;

- there are no powers of public authorities to formulate and implement policy in this area, as well as to regulate relations between the 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 stipulates that the provisions of this Law on natural gas shall be applied on a non-discriminatory basis to biogas or other gas from alternative sources, if biogas or other gas from alternative sources meets the requirements for access to gas transportation and gas distribution systems, gas storage facilities, and LNG facilities. Given the different physical and chemical parameters of hydrogen and CO2, this provision cannot be used to expand the scope of public authorities' powers over hydrogen, as required by Article 19 of the Constitution of Ukraine. Moreover, this would be inadequate given the different levels of market development. We are talking about the powers of both the Regulator (NEURC) and the Ministry of Energy in terms of technical rules and security of supply in the natural gas market.

The Law of Ukraine "On the NEURC" lists the areas within which the NEURC exercises its powers, and hydrogen is not among them. This means that the NEURC cannot exercise its supervisory functions in relation to hydrogen and CO2 projects and proposals (e.g., to include the relevant project in the 10-year GTS/UGS development plan or to grant the right to use the tariff revenue of the GTS/UGS operator for these purposes).

- there are no responsibilities and powers of operators of the future hydrogen infrastructure;

Today, the most active role in the development of hydrogen infrastructure is played by GTS Operator of Ukraine LLC, which is an ISO-certified GTS operator. Ukrtransgaz JSC (the UGS operator) is conducting separate studies on readiness to receive hydrogen. At the same time, the law does not define the tasks, rights and obligations of operators of hydrogen transportation, storage and distribution systems.

- conditions for eliminating double counting of electricity from renewable sources used for hydrogen production.

In this regard, in 2024-2025, with the involvement of international technical assistance, the legal framework for the functioning of hydrogen and CO2 markets will be developed with due regard to the approaches that will be finally adopted in the amendments to EU gas law, namely in the following key aspects:

- providing the necessary legislative definitions;

- legislative extension of the powers of public authorities to cover relations in the field of hydrogen and CO₂;
- Legislative consolidation of the basic structure of the hydrogen and, if necessary, CO₂ market, as well as safeguards against double counting of energy.

PM_IMG_WAM_02 Creating legal conditions for optimization of oil and gas infrastructure

Objective: to remove legal obstacles to optimize oil and gas infrastructure in line with the goals of the NEC

Legal basis: ESU

Timeframe: 2024-2025

Responsible authorities/organizations: VRU, Cabinet of Ministers of Ukraine, Ministry of Energy

Description: The Draft Law of Ukraine No. 6133 "On Amendments to the Law of Ukraine "On Oil and Gas" on the Identification of Critical Gas Storage Facilities and Critical Gas Transmission Pipelines" is being prepared for the second reading in the Verkhovna Rada of Ukraine²⁸⁷, which should allow some operators and authorities to carry out relevant work. The need to adopt the draft law, as well as to create a regulatory framework based on it (a resolution of the CMU and other state property management bodies), is emphasized by natural gas market players, as it is a prerequisite for both projects to optimize oil and gas infrastructure and for the possibility of expanding the activities of its operators to other types of gases (e.g., hydrogen).

Taking into account the expected adoption of the draft law, it is necessary to approve the necessary bylaws for its implementation in 2024.

PM_IMG_WAM_03 Establishing systematic involvement of the Ukrainian side in EU processes related to the future of energy infrastructure

Objective: to ensure that Ukraine's energy infrastructure is taken into account in the development of energy markets in the EU

Legal basis: Art. 274 of the Association Agreement, Memorandum of Understanding on the Strategic Energy Partnership between Ukraine and the European Union together with the European Atomic Energy Community

Timeframe: 2024-2025

Responsible authorities/organizations: Ministry of Energy, Ministry of Foreign Affairs, Ministry of Education and Science

Description: Energy infrastructure planning in the EU is an ongoing and complex process, which includes, inter alia, the stages of developing, discussing and approving the EU's 10-year network development plans (TYNDP) and lists of projects of common/mutual interest (PCI/PMI list), applying for and obtaining coordinated decisions on cross-border cost sharing, applying for and reviewing funding from the

²⁸⁷ <https://itd.rada.gov.ua/billInfo/Bills/CardByRn?regNum=6133&conv=9>

Connecting Europe Facility, and applying for and participating in projects to finance advanced research in this area, in particular through the EU Innovation Fund.

At the level of EU strategic documents, Ukraine's potential is not always taken into account. Ukraine and Ukrainian companies rarely participate in large-scale research projects (except, for example, the Biomethaverse project, in which non-state actors from Ukraine are involved). The participation of Ukrainian companies in the TYNPD, PCI/PMI list and, accordingly, the Connecting Europe Facility is ad hoc; in the context of the participation of public sector companies, it is not coordinated, despite the fact that the GTSOU is an observer in ENTSOG and the TSO is a full member of ENTSO-e.

The Ukrainian side will take measures to ensure that the Ukrainian energy infrastructure is taken into account during the processes:

- development of strategic documents and relevant internal EU studies conducted with the help of third-party contractors or the Joint Research Center of the European Commission;
- planning and implementation of large-scale research projects (see also PM_RIC_WAM_02 Expanding funding for research in renewable energy and climate innovation);
- planning and financing of critical elements of future energy infrastructure (in particular, through TYNPD procedures, the list of PCI/PMI projects of the European Commission, the United Europe Facility, and the European Hydrogen Bank);
- creation and functioning of the infrastructure for decarbonization of energy markets, including traceability systems and mutual recognition of guarantees of origin in accordance with the RED III Directive.

In addition, it is advisable to obtain full membership of the Ukrainian side in the EU standardization bodies (CEN, CENELEC), as well as in ENTSOG.

For this purpose, additional agreements should be reached with the European side, and additional organizational measures should be taken by the Ukrainian side.

ii. Regional cooperation in this area

Electricity infrastructure

Regional cooperation in the development of Ukraine's electricity transmission system is envisaged mainly within the framework of planning and implementation of projects that strengthen the cross-border electricity connections of the IPS of Ukraine with the power systems of ENTSO-E member states to improve their level of integration. Such projects are agreed by TSOs within the Energy Community and implemented in the format of projects of mutual interest (PMI). At the same time, Ukraine is currently not implementing projects aimed at developing the transmission system in the format of projects of common interest of the EU (PCI) or the Energy Community (ECI).

In order to develop regional cooperation, the TSO of Ukraine will further cooperate with the TSOs of other countries of the region in the format of interaction with the regional coordination center (RCC) provided for by Regulation (EU) 2019/943 on the internal market in electricity. The interaction will be carried out within the framework of the functionality defined in Annex 1 to this Regulation,²⁸⁸, in particular, in terms of creating a regional grid model, coordinated mode calculations and determining corrective actions in the region, determining the capacity of interstate cross-border crossings for distribution, etc.

Oil and gas infrastructure

The GTSOU cooperates with operators of adjacent gas transmission systems within ENTSOG and other initiatives:

²⁸⁸ <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A02019R0943-20220623#M1-1>

- High Level Group for Gas Connectivity of Central and Southeast Europe (CESEC);
- South-East European Gas Initiative (SEEGAS);
- European Hydrogen Backbone and other hydrogen initiatives;
- Biomethane Industrial Partnership, in particular, thematic area 6.

iii. If applicable, funding measures in this area at the national level, including Union support and use of Union funds

Electricity infrastructure

Several sources are used to finance the development of the transmission system, the main ones being:

- a tariff for electricity transmission services that contains an appropriate investment component to finance projects for the modernization and development of the transmission system;
- revenues received by TSOs at auctions for the allocation of access to interstate network capacity;
- 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 TSO's electricity transmission tariff is determined in accordance with the Procedure for Setting (Formation) of the Tariff for Electricity Transmission Services and is subject to approval by the Regulator.²⁸⁹ The transmission tariff, in particular, contains the costs of implementing the TSO's investment program, which determines the amount and sources of funding for planned transmission system development projects. The investment program is formed in accordance with the Procedure for Formation of Investment Programs of Licensees for the Transmission of Electricity by Trunk and Interstate Power Grids and for the Production of Heat and/or Electricity at Nuclear Power Plants, Hydroelectric Power Plants and Pumped Storage Power Plants (²⁹⁰) and is also reviewed and approved by the Regulator.

Pursuant to Article 43 of the Law of Ukraine "On the Electricity Market", any revenues from the distribution of cross-border transmission capacity may be used for the following purposes: guaranteeing the actual availability of the distributed transmission capacity; maintenance and increase of transmission capacity by investing in the transmission system, in particular in the construction of new interstate transmission lines.

Along with the need to develop and modernize the transmission system in the volumes determined by the TSO, the TSO also has contractual obligations to develop the transmission system for the connection of customers' facilities. At the same time, the financing of the transmission system development necessary for the connection of customers' facilities is carried out at the expense of connection fees from customers. The formation of the fee for connection to the TSO's networks is determined in accordance with the Methodology (procedure) for the formation of the fee for connection to the transmission and distribution systems.²⁹¹

Methods of financing transmission system modernization and development projects with IFI funds are described in section 3.4.1.iii.

Oil and gas infrastructure

²⁸⁹ <https://zakon.rada.gov.ua/laws/show/v0585874-19#Text>

²⁹⁰ <https://zakon.rada.gov.ua/laws/show/z0840-15#n12>

²⁹¹ <https://zakon.rada.gov.ua/laws/show/v1965874-18#Text>

The costs of oil and gas infrastructure operators can be financed from the revenue received from customers of their services or from additional sources. For example, the Central European Hydrogen Corridor project is applying for funding from the United Europe Facility. Funding for hydrogen projects is also available from Horizon Europe, the EU Innovation Fund, including the European Hydrogen Bank, etc. At the same time, as noted above, financing of the costs of natural gas and oil transportation and storage infrastructure, which will not be further repurposed for hydrogen activities, will no longer be eligible for funding from the main EU financing mechanisms (including the United Europe Facility). Thus, the main source of funding for the necessary measures may be revenue from service customers, with the possibility of attracting credit financing.

The ESU stipulates 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 sustainability of the GTS. In 2025-2029, the second regulatory period for incentive tariff setting will last for the GTS Operator of Ukraine LLC, whose required revenues will include the costs of projects specified in the NECP. At the same time, gas transit from Russia to the EU is expected to stop in 2025, and oil transit from Russia and the Republic of Belarus is also expected to decrease.

Even if we assume that martial law will end by the end of 2025, the current law will continue to impose a moratorium on raising tariffs for natural gas distribution during the first half of 2026, which will limit the ability of such operators to finance their expenses.

Thus, sources should be provided to finance the costs of implementing the projects envisaged in the NEC, in particular by including the relevant costs in the tariffs of the respective operators.

3.4.3. Market integration

i. Policies and measures related to the elements identified in [2.4.3](#)

Electricity market

In 2019, Ukraine carried out a fundamental reform of the wholesale and retail segments of the electricity market, moving from a single buyer model to a competitive market model based on the EU model by introducing an appropriate institutional environment and structural organization of the market as provided for in the EU Third Energy Package. Further transformation of the electricity market is taking place within the framework of the EU's Fourth Energy Package (Clean Energy Package). In terms of reforming and developing the electricity market, Ukraine is implementing the following basic policies and measures:

- Deepening integration with the EU and ENTSO-E markets by increasing the capacity of interstate networks and introducing European rules for its allocation at joint auctions using the European trading platform Joint Allocation Office (JAO). It is also planned to unite the spot markets of Ukraine and the EU countries as soon as possible, in particular the day-ahead market and the intraday market (market coupling).
- Ensuring the 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 EU and ENTSO-E markets. At the same time, it is envisaged to gradually harmonize with the EU markets the areas, methods, scale and other parameters of regulation, in particular in terms of applying price caps on the spot (DAM, IDM) and balancing electricity markets.
- Developing electricity exchange trading with the introduction of standardized trading products, introducing market-based pricing in all market segments, including the use of real-time prices, and gradually abandoning cross-subsidization.

- Introduction of tariffs for electricity transmission and distribution services based on the regulatory asset base (RAB-tariffs) for the transmission system operator (TSO) and distribution system operators (DSO) to ensure economic conditions for the modernization of the network infrastructure and the introduction of "smart grids".
- Increasing the resilience and flexibility of the power system through the development of distributed generation, the introduction of shunting generating capacities, energy storage facilities and demand management measures. Based on the priorities for technological development of the IPS of Ukraine, determined by the TSO as part of the resource adequacy/reliability assessment, in particular in terms of the structure of generating and other capacities, it is envisaged to hold tenders for the construction of generating capacity and implementation of demand management measures with appropriate incentive (support) mechanisms.
- Deepening the market integration of RES electricity producers by ensuring their active participation in organized market segments and the possibility of direct electricity trading, taking into account responsibility for imbalances.
- Ensuring the protection of vulnerable consumers through direct monetized subsidies, preferential prices, and mechanisms for imposing special obligations on certain market participants to ensure the public interest in the operation of the electricity market (PSO), which should be temporary, targeted and non-discriminatory.

The individual policies and measures are described in more detail in subparts. 3.4.3.iii-3.4.3.v.

ii. Measures to increase the flexibility of the energy system in the context of renewable energy production, such as smart grids, aggregation, demand management, energy storage, distributed generation, dispatch, re-dispatch and curtailment mechanisms, real-time price signals, including the introduction of the interconnection of intraday markets and cross-border balancing markets

Electricity market

PM_IME_WAM_01 Implementation of smart grids

Objective: Implementation of smart grids, taking into account existing and planned measures of the state and regional programs of development and modernization of the energy sector. The expected results of the implementation of the Concept of Smart Grid Implementation in Ukraine by 2035 are as follows:

- Improving the reliability and quality of electricity supply, operational performance and overall productivity of the energy sector;
- improving operational efficiency, efficient integration of distributed generation, remote monitoring and diagnostics, optimization of asset and resource utilization, and improvement of power grid configuration;
- Increasing energy efficiency, which will reduce losses in the power grids of transmission and distribution system operators, improve the efficiency of load management (active and reactive), and reduce carbon emissions;
- reducing the frequency and duration of consumer outages;
- providing consumers with the opportunity to manage their electricity consumption, reduce energy costs without compromising their lifestyle and excessive restrictions on electricity consumption to meet their own household needs (the expected reduction in the average duration of long interruptions in the system's electricity supply (SAIDI) and the Electricity not Supplied index by 2030 is at least three times).

Legal basis: Order of the Cabinet of Ministers of Ukraine dated October 14, 2022 No. 908-r "On Approval of the Concept for the Implementation of Smart Grids in Ukraine until 2035".

Timeframe: 2022 - 2035.

Responsible authorities/organizations: Ministry of Energy, NEURC

Description: The development of smart grids will be carried out within the framework of the Concept for the Implementation of Smart Grids in Ukraine by 2035 and the corresponding action plan for its implementation approved by the Government in 2022.²⁹² The implementation of pilot projects specified in the action plan for the implementation of the Concept is envisaged on the basis of the property of business entities (operators of the EMS, TSOs, DSOs, electricity producers). The projects are implemented using the procedures for forming development plans and investment programs of electricity producers, TSOs, DSOs, and plans for the reconstruction and modernization of TPPs and CHPs approved by the NEURC.

The concept envisages the implementation of pilot smart city projects, namely the integration of information and communication technologies, to effectively manage the city's infrastructure. Efforts are aimed at improving the quality of life of city residents and reducing infrastructure maintenance costs.

Implementation of the Concept does not require expenditures from the state and local budgets. The main current source of funding for the development of smart grids is the TSO's tariff for electricity transmission services and the DSO's tariffs for electricity distribution services. The tariffs are regulated by the national regulator (NEURC), subject to annual review and approval, and, in particular, should take into account the costs of implementing grid development measures envisaged in the medium- and long-term plans for the development of the transmission and distribution systems, as well as the relevant annual investment programs of grid operators. Grid development plans and investment programs are subject to approval by the Regulator.

The Ministry of Energy ensures coordination of actions, control and monitoring of the Concept implementation and the implementation of the action plan. The instrument for implementing the Concept is the relevant action plan with defined performance indicators.

PM_IME_WEM_01 Incentive regulation of distribution system operators

Objective: To stimulate investment in the modernization and development of power grids, and to achieve targets for the quality and reliability of electricity supply.

Legal basis: Resolution of the NEURC No. 1175 "On Approval of the Procedure for Setting (Formation) of Tariffs for Electricity Distribution Services" of 05.10.2018²⁹³

Timeframe: since 2018

Responsible authorities/organizations: NEURC, DSOS

Description: Tariffs for distribution services for the vast majority of DSOs are based on the principle of incentive-based regulation (RAB-tariffs), which is aimed at stimulating investment in the modernization and development of electricity networks, as well as achieving target indicators for the quality and reliability

²⁹² <https://zakon.rada.gov.ua/laws/show/908-2022-%D1%80#Text>

²⁹³ <https://zakon.rada.gov.ua/laws/show/v1175874-18#Text>

of electricity supply by determining the necessary income of the DSO to ensure the implementation of electricity distribution activities.

PM_IME_WAM_02 Aggregation development

Objective: To create an institutional environment for aggregation activities in the electricity market.

Legal basis: *The Law of Ukraine "On the Electricity Market", NEURC Resolution No. 1909 dated 18.10.2023 "On Approval of the License Terms for Conducting Business Activities for Aggregation in the Electricity Market and Amendments to Certain NEURC Resolutions".*

Timeframe: from 2023.

Responsible authorities/organizations: Verkhovna Rada of Ukraine, NEURC.

Description: Aggregation activities are subject to licensing, unless the market participant has a license to produce and/or store and/or supply electricity to consumers and/or to act as a guaranteed buyer.²⁹⁴ To avoid excessive concentration, the key restrictions on aggregator activities include the condition that the aggregation unit may not include an electrical installation designed to produce electricity with an installed capacity exceeding 20 MW.

In terms of market participation, the aggregator may, on a non-discriminatory basis, purchase and sell electricity in the electricity market, taking into account liability for imbalances, and provide balancing and ancillary services (in accordance with the law).²⁹⁵

Market participants have the right to freely join and leave an aggregated group. Withdrawal from the aggregated group shall be carried out as soon as possible, subject to the terms of the agreement, but such period may not exceed 21 calendar days. At the same time, agreements on participation in an aggregated group may provide for penalties (fees) for the withdrawal of an electrical installation from the aggregated group. Such penalties (fees) shall be proportional and shall not exceed the direct losses and/or expenses of the aggregator as a result of the termination of the agreement, including the cost of services already provided under the agreement. Penalties (fees) may not be applied to household and small non-household consumers.

PM_IME_WAM_03 Application of pilot projects and demand side management program

Objective: To develop technical capabilities and stimulate the management of electricity demand of household consumers.

Legal basis: ESU

Timeframe: 2023 - 2032.

Responsible authorities/organizations: Ministry of Energy.

Description: The ESU envisages the implementation of pilot projects and the creation of a demand response program by 2032. The program will include a set of regulatory and technical measures, which will include

²⁹⁴ <https://zakon.rada.gov.ua/rada/show/v1909874-23#Text>

²⁹⁵ <https://zakon.rada.gov.ua/laws/show/2019-19#n2968>

centralized state procurement and controlled sale at preferential prices to household consumers of standardized minimum capacity (one per private house/apartment), smart sockets and smart meters, as well as the use of differentiated 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 Ensuring the development of energy storage facilities

Objective: To create an institutional environment for energy storage activities and participation of energy storage operators in the electricity market.

Legal basis: The Law of Ukraine "On the Electricity Market", NEURC Resolution No. 798 dated 22.07.2022 "On Approval of the Licensing Conditions for Conducting Economic Activities in Energy Storage", ESU

Timeline: from 2022.

Responsible authorities/organizations: Verkhovna Rada of Ukraine, NEURC.

Description: The development of SPPs is at an early stage (there are two industrial SPPs with a capacity of 1 MW each in the IPS of Ukraine). Since the installed RES capacities in Ukraine until 2023 are based on technologies whose operation profile depends on weather conditions (especially wind and sun) and which operate with a low level of ICF, it is planned to expand the grid infrastructure and develop ESS. According to the ESU, among the strategic objectives until 2025 is the active implementation of energy storage technologies with further expansion of their use in the following time horizons. It also provides for the creation of incentives/market conditions for the construction of industrial-scale ESS.

Energy storage activities are provided for in the Law of Ukraine "On the Electricity Market". The regulator has approved the license conditions for energy storage activities.²⁹⁶ To simplify licensing procedures, the license conditions define cases when entities using energy storage facilities do not require licensing.

In addition, to simplify the procedure for connecting the EMI to the power grids 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 DSO shall connect the EMI of customers until January 1, 2025 without paying for the connection of power.²⁹⁷

In terms of market participation, the EMS operator (as well as the aggregator) may, on a non-discriminatory basis, purchase and sell electricity on the electricity market, taking into account liability for imbalances, as well as provide balancing and ancillary services.²⁹⁸

The development of relatively small SPPs will be partially stimulated through the State Target Economic Program for Stimulating the Development of Distributed Generation of Electricity from Renewable Energy Sources for the Period up to 2030 (see below).

²⁹⁶ <https://zakon.rada.gov.ua/rada/show/v0798874-22#Text>

²⁹⁷ <https://zakon.rada.gov.ua/rada/show/v0352874-22#Text>

²⁹⁸ <https://zakon.rada.gov.ua/laws/show/2019-19#n2968>

PM_IME_WEM_02 Support of active consumers by the mechanism of self-production (net billing)

Objective: To create an institutional environment for the participation of active consumers in the electricity market and to stimulate the development of distributed sources of electricity generation.

Legal basis: The Law of Ukraine "On Amendments to Certain Laws of Ukraine on Restoration and Green Transformation of the Energy System of Ukraine", the Law of Ukraine "On the Electricity Market", NEURC Resolution No. 2651 dated 29.12.2023 "On Approval of the Procedure for Sale and Metering of Electricity Generated by Active Consumers and Payments for It".

Timeline: from 2024.

Responsible authorities/organizations: Verkhovna Rada of Ukraine, NEURC

Description: Support for active consumers under the self-generation mechanism (SGM) is provided by guaranteeing the purchase of electricity generated mainly from alternative sources and supplied to SGM on the basis of a signed power purchase agreement under the self-generation mechanism, which is an annex to the electricity supply agreement with the consumer.²⁹⁹ The self-generation mechanism is a support scheme for active consumers designed to encourage the consumption of electricity of their own production, under which the cost of electricity supplied to the grid by generating facilities of such consumers and the cost of electricity withdrawn from the grid, taking into account the cost of transmission and/or distribution services, are offset.

The self-generation mechanism provides for the possibility for household and non-household consumers to install generating capacities within their contractual capacity (but not more than 30 kW for household consumers and 50 kW for small non-household consumers). Technical requirements related to the connection of ASMS generating facilities are determined by the distribution system code and the transmission system code. The electric power of an ASMS (except for a household consumer and a small non-household consumer) allowed to be supplied to the grid may not simultaneously exceed 50% of the permitted (contractual) capacity of the electrical installations of such a consumer intended for the consumption of electric energy. An ASMS with an installed capacity of generating electrical installations of more than 1 MW shall not supply to the grid more than 50% of its total electricity consumption for the relevant year. Otherwise, such a consumer loses the status of an ASMS for a calendar year.

The ASMS must conclude a power purchase agreement under the self-generation mechanism with its electricity supplier. The sale price of electricity by household and small non-household consumers is determined at the level of prices prevailing on the DAM in the relevant period. The sale price of electricity by non-household consumers is determined by agreement of the parties. The universal service provider may not refuse a household or small non-household consumer to conclude a contract for the sale and purchase of electricity under the self-production mechanism, provided that such a consumer has concluded an electricity supply agreement.

The sale, metering of electricity generated by active consumers and payments for it must be made in accordance with the Procedure for the Sale and Metering of Electricity Generated by Active Consumers and Payments for It approved by the Regulator³⁰⁰.

²⁹⁹ <https://zakon.rada.gov.ua/laws/show/555-15#n505>

³⁰⁰ <https://zakon.rada.gov.ua/rada/show/v2651874-23#Text>

PM_IME_WAM_05 State Targeted Economic Program for Stimulating the Development of Distributed Generation of Electricity from Renewable Energy Sources for the Period up to 2030

Objective: To stimulate the development of distributed generation of electricity from renewable energy sources and energy storage facilities.

Legal basis: Draft Concept of the State Targeted Economic Program to Stimulate the Development of Distributed Electricity Generation from Renewable Energy Sources for the Period up to 2030.

Timeline: 2025 - 2030.

Responsible authorities/organizations: Ministry of Energy.

Description: The draft Concept of the State Targeted Economic Program provides for the stimulation of the installation of photovoltaic modules and/or wind power plants with a hybrid inverter that can operate both in autonomous mode and in synchronization with the grid, including together with a power supply system, to cover the own electricity consumption of critical infrastructure facilities and households in autonomous mode. If appropriate, the relevant facilities can be equipped with heat pumps³⁰¹.

Installation of power supply systems is planned through the introduction of state support mechanisms in the form of:

- reimbursement of a part of the loan amount for the purchase and installation of a power supply system and a heat pump (if applicable);
- reimbursement of part of the interest on a loan for the purchase and installation of a power supply system and a heat pump (if applicable);
- supplying equipment as part of international technical assistance;
- other mechanisms not prohibited by law.

The first phase (2024-2026) will provide support for:

- 1) state-owned and municipally owned business entities to install photovoltaic modules and/or wind power plants up to 500 kW (per facility) together with hybrid inverters and UPS with a capacity that will allow for autonomous power supply to critical infrastructure facilities for at least 4 hours. These critical infrastructure facilities include: centralized water supply and sewage systems; district heating systems (boiler houses, central heating stations); and healthcare facilities;
- 2) associations of co-owners of apartment buildings for the purpose of supplying electricity to public current collectors that ensure the life of apartment buildings (heating systems/individual heating points, water supply, elevators, circulation/fire pumps, lighting, alarms, smoke removal, etc.);
- 3) household consumers in private households for the installation of photovoltaic modules and/or wind power plants with an installed capacity of up to 10 kW, together with hybrid inverters and UPS in the ratio of 1 kW of installed capacity of the generating unit to at least 0.5 kWh of UPS capacity.

The second phase (2027-2030) will extend support to other state-owned and municipally owned facilities (administrative buildings, educational institutions, etc.) and extend state support to household consumers for the installation of power supply systems in private households.

³⁰¹ https://www.mev.gov.ua/projekt-normatyvno-pravovoho-aktu/povidomleniya-pro-oprylyudnennya-proyektu-rozporyyadzhennya-1?fbclid=IwAR3joj5zMtABsALIEyu-6P9Ksao48cA91xlxgSGUaT-ydYA_REaaQVrX1vI

The goal of the Program is to stimulate the achievement of 200 thousand power supply systems installed by active consumers during the first stage of the Program, with a further increase to 500 thousand power supply systems by the end of the second stage by 2030. The functioning of power supply systems in the electricity market is envisaged by the self-production mechanism (Net Billing model). The Program implementation period is 2024-2030.

PM_IME_WAM_06 Tenders for the construction of generating capacity and implementation of demand response measures

Objective: To stimulate the construction of new generating capacities and the implementation of demand management measures to ensure resource adequacy and flexibility of the power system.

Legal basis: The Law of Ukraine "On the Electricity Market", Resolution of the Cabinet of Ministers of Ukraine No. 677 dated July 10, 2019 "On Approval of the Procedure for Holding a Tender for the Construction of Generating Capacity and Implementation of Demand Side Management Measures".

Timeframe: from 2024.

Responsible authorities/organizations: Cabinet of Ministers of Ukraine, Ministry of Energy, NEURC, transmission system operator.

Description: To ensure the resource adequacy (sufficiency) and flexibility of the power system based on the priorities of technological development of the IPS of Ukraine, determined by the TSO as part of the resource adequacy/sufficiency assessment, in particular in terms of the structure of generating and other capacities, the state plans to hold tenders for the construction of generating capacity and implementation of demand management measures in accordance with the approved procedure for their holding.³⁰² The tenders are held on the principles of non-discrimination and fair competition among participants; openness and transparency; objective and impartial evaluation of bids; prevention of corruption and abuse during the tender.

The TSO, based on the report on the assessment of compliance (sufficiency) of generating capacities and the results of monitoring the security of electricity supply, shall submit to the Ministry of Energy conclusions and proposals on the need to hold a tender, the volume of procurement of generating capacity and/or demand management measures, the minimum and maximum amount of additional capacity and/or the amount of impact on the electricity load schedule due to demand management, technical requirements and characteristics of generating capacities and/or equipment for

The decision to hold the tender is made by the Cabinet of Ministers of Ukraine upon the proposal of the Ministry of Energy and determines the tender:

- 1) the terms of the competition;
- 2) the amount of procurement of the required generating capacity and/or demand-side management measures;
- 3) incentives and the procedure for their application for the winner of the tender, including the maximum purchase price for the service to ensure the development of generating capacity and the minimum deadline for payment for the service provided if the payment for the service to ensure the development of generating capacity is used as an incentive;

³⁰² <https://zakon.rada.gov.ua/laws/show/677-2019-%D0%BF#Text>

- 4) maximum deadline for commissioning of generating capacity and/or commencement of demand response measures;
- 5) minimum and maximum values of additional capacity and/or values of the impact on the electricity load schedule as a result of demand response measures;
- 6) requirements for the minimum guaranteed (design) service life (operating hours) of equipment after commissioning of generating capacity and/or demand-side management measures;
- 7) basic technical requirements and characteristics to ensure the required operating modes of generating facilities and/or equipment for demand-side management measures.

The following support mechanisms may be used to encourage the winners of the competition:

- payment for the service to ensure the development of generating capacities and/or demand response measures, which does not exceed the maximum purchase price for the service to ensure the development of generating capacities and/or demand response measures. Such payment is made by including the relevant costs in the TSO's electricity transmission tariff;
- mechanism of public-private partnership (the tender is held in accordance with the Law of Ukraine "On Public-Private Partnership");
- facilitating land allocation and/or site allocation for the construction of new generating capacity (involves the conclusion of an agreement between the state or local government and the winner of the tender for the provision (transfer) of a land plot from state or municipal property to ownership or use and an agreement with the TSO for the provision of services to ensure the development of generating capacity and/or demand management measures);
- provision of state aid at the expense of state or local resources.

Decentralization of electricity production and an increase in flexible capacities will support energy security at the local level. The government plans to streamline the procedures for conducting auctions for the construction of highly maneuverable capacities with the ability to quickly start/stop energy storage facilities to speed up the process.

PM_IME_WEM_03 Simplification of permitting procedures for distributed generation entities (temporary measures)

Objective: To stimulate the development of distributed electricity generation by reducing the regulatory burden on developers of cogeneration plants and mobile (autonomous) power plants.

Legal basis: NEURC Resolution No. 2053 dated 01.11.2023 "On Amendments to the Licensing Conditions for Conducting Business Activities for the Production of Thermal Energy", NEURC Resolution No. 725 dated 25.04.2023 "On Amendments to the Licensing Conditions for the Production of Electric Energy".

Timeframe: during the period of martial law and six months after its termination or lifting.

Responsible authorities/organizations: NEURC.

Description: The regulator (NEURC) has amended the Licensing Conditions for Conducting Economic Activities for the Production of Thermal Energy (effective from November 2, 2023) to simplify the conditions for the operation of cogeneration plants 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.³⁰³ This provision is temporary and will be in effect during the period of martial law in Ukraine and for six months after its termination or lifting. The purpose is to reduce the regulatory burden on developers of cogeneration plants

³⁰³ <https://www.nerc.gov.ua/acts/pro-vnesennya-zmini-do-licenzijnih-umov-provadzhennya-gospodarskoyi-diyalnosti-z-virobnictva-teplovoyi-energiyi>

to supply heat, water, sewage, and social facilities (education, healthcare (except for sanatoriums)) during emergency power outages.

The Regulator has amended the Electricity Generation License Terms (effective from 25 April 2023), according to which electricity generation 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 generation.³⁰⁴ This provision is temporary in nature and is valid during the period of martial law in Ukraine and for six months after its termination or cancellation.

PM_IME_WEM_04 Prioritization of renewable energy sources in dispatching

Objective: Ensuring conditions for increasing the volume of electricity generation from renewable sources in the dispatching of electricity facilities in the power system.

Legal basis: The Law of Ukraine "On the Electricity Market", the Transmission System Code.

Timeframe: since 2018.

Responsible authorities/organizations: NEURC, transmission system operator.

Description: According to the Transmission System Code (TSC), the following priorities are given to the dispatching of renewable energy facilities:

- inclusion of all declared generating capacities in the dispatching load schedule for the next day;
- priority load of generating facilities when implementing the dispatchable load schedule;
- postponement, subject to ensuring the operational security of the grid, of unloading or shutting down generating capacities.

At the same time, priorities are not given to RES facilities in the event of violations of grid operational security, emergencies or emergencies, if the measures necessary to normalize the operation of the IPS of Ukraine involve incomplete loading, unloading or disconnection of these power plants.

In addition, when dispatching generating capacities, the TSO applies non-discriminatory, competitive and transparent market mechanisms when planning and implementing load schedules for generating capacities and load-following devices.

PM_IME_WEM_05 Provision of compensation for restrictions on RES producers (at the "green" tariff) during redispatch

Objective: To create favorable economic conditions for the operation of RES generation facilities in the face of restrictions on electricity supply by the transmission system operator.

Legal basis: The Law of Ukraine "On the Electricity Market".

Timeframe: 2018 - 2029.

³⁰⁴ <https://www.nerc.gov.ua/acts/pro-vnesenya-zmin-do-licenzijnih-umov-z-virobnictva-elektrichnoyi-energiyi>

Responsible authorities/organizations: NEURC, transmission system operator, guaranteed buyer.

Description: In the case of restrictions on electricity production by facilities using alternative energy sources, in order to ensure operational security of the grid and security of electricity supply, the TSO shall provide the Regulator with information on such restrictions, indicating the reasons and measures it plans to take to prevent restrictions.³⁰⁵ In addition, the application of systemic restrictions by RES electricity producers operating under the feed-in tariff mechanism shall be compensated to these producers by the TSO in the form of the purchase of load reduction services by the producer selling electricity under the feed-in tariff at the expense of the costs included in the tariff for electricity transmission services. The cost of the load reduction service provided by the producer selling electricity under the feed-in tariff as a result of the TSO's order is equal to the cost of electricity not supplied by such producer under the feed-in tariff.³⁰⁶

At the same time, such compensation to producers operating under the feed-in tariff mechanism will be provided until 2029 inclusive (as long as the feed-in tariff mechanism is in force). Starting from 2030, financial compensation for the reduction in electricity production by RES producers resulting from TSOs' unloading commands will be provided on a non-discriminatory basis, according to market rules and at unloading prices established in the balancing market.

PM_IME_WAM_08 Implementation of real-time pricing

Objective: To provide correct price signals for market participants based on the real supply and demand ratio.

Legal basis: The Law of Ukraine "On the Electricity Market" (Article 19).

Timeline: from 2025.

Responsible authorities/organizations: NEURC.

Description: The policy provides for the creation of preconditions for a more flexible and objective reflection of the dynamics of the supply-demand ratio in the organized segments of the electricity market through prices, as well as for deepening its integration with the electricity markets of the EU countries (market coupling).

Reducing the duration of settlement periods. In the organized segments of the Ukrainian spot electricity market (DAM, IDM) and the balancing market, marginal pricing is applied on a competitive basis. Prices in all three market segments are the result of the interaction of supply and demand in each specific billing period of the day and are determined on an hourly basis. In order to reflect the dynamics of supply and demand in the market in more detail, the possibility of using a larger number of settlement periods in the DAM, IDM and balancing market is being considered by reducing their duration to 30 minutes and 15 minutes.

Introduction of negative prices. The full introduction of real-time prices will provide for the possibility of negative electricity prices on the DAM, IDM and balancing market depending on the dynamics and ratio of supply and demand in each individual billing period. This will provide objective signals to market participants for rational market behavior and economic actions, including stimulating electricity

³⁰⁵ <https://zakon.rada.gov.ua/laws/show/v0309874-18#Text>

³⁰⁶ <https://zakon.rada.gov.ua/laws/show/2019-19#n2968>

consumption, investing in flexible generation and storage capacities, managing demand, and improving forecasting.

PM_IME_WEM_06 Harmonization of the application of price caps in wholesale market segments

Objective: To harmonize the application of price caps in the wholesale segments of the electricity market with European markets.

Legal basis: The Law of Ukraine "On the Electricity Market" (Article 6).

Timeline: from 2025.

Responsible authorities/organizations: NEURC.

Description: It is envisaged to gradually harmonize price regulation, which is carried out in the form of setting maximum and minimum price caps on the DAM, IDM and balancing electricity market of Ukraine, with European approaches to price caps. This will provide correct price signals to all market participants to make investments and optimize market behavior. Such harmonization is one of the key prerequisites for deepening the integration (unification) of the relevant segments of the Ukrainian electricity market with European markets.

PM_IME_WAM_09 Integration (coupling) of spot markets (market coupling)

Objective: To ensure the integrated operation of the day-ahead market and the intraday market of Ukraine with the relevant segments of the EU electricity markets.

Legal basis: Plan for the Ukraine Facility,³⁰⁷ implementation of the Electricity Integration Package.³⁰⁸

Timeline: 2024-2026.

Responsible authorities/organizations: NEURC, VRU, CMU, JSC Market Operator

Description: In order to increase transparency, competitiveness, liquidity of the Ukrainian electricity market, ensure more efficient allocation of available cross-border capacity and better operational security, the organized segments of the Ukrainian electricity market (DAM and IDM) should be coupled with the relevant markets of European countries (market coupling).

To implement the policy of merging the DAM and the WDR, a reform should be implemented, which includes the following steps: 1) implementation of the electricity market integration package, 2) adoption and entry into force of legislation to change the taxation of electricity market participants, 3) determination of the nominated electricity market operator (NEMO), 4) implementation of the Law of Ukraine No. 3141-IX of June 10, 2023 "On Amendments to Certain Laws of Ukraine on Prevention of Abuse in Wholesale Energy Markets" (REMIT), which will allow the Regulator to exercise full market oversight.

³⁰⁷ <http://www.ukrainefacility.me.gov.ua/wp-content/uploads/2024/03/plan-ukraine-facility.pdf>

³⁰⁸ <https://www.energy-community.org/implementation/package/EL.html>

The electricity market integration package is expected to be adopted by Q4 2025. Legislation harmonizing Ukrainian legislation with the Clean Energy Package will be adopted and enter into force. The NEURC will determine the nominated electricity market operator, which will be appointed by Q4 2025.

By the 2nd quarter of 2026, legislation will be adopted to change the regimes of indirect taxation and foreign economic activity of electricity market participants as part of the implementation of Energy Community legislation, introduced by the decision of the Council of Ministers of the Energy Community of December 15, 2022 No. D/2022/03/MC-EnC on the implementation of Regulation (EU) 2019/942, Regulation (EU) 2019/943, Regulation (EU) 2015/1222, Regulation (EU) 2016/1719, Regulation (EU) 2017/2195, Regulation (EU) 2017/2196, Regulation (EU) 2017/1485, and amending Council Decisions 2021/13/MC-EnC and 2011/02/MC-EnC. The Tax and Customs Codes of Ukraine will be amended to regulate the calculation and sources of payment of value added tax on electricity exports, calculation and sources of payment of excise tax and import duty on electricity imports. The list of specific laws will be finalized after the adoption of the basic Law of Ukraine on the Transposition of the Electricity Integration Package.³⁰⁹

PM_IME_WAM_10 Integration (merger) of the balancing market

Objective: To ensure the integrated operation of the balancing electricity market of Ukraine with the relevant segment of the EU markets.

Legal basis: Plan for the Ukraine Facility, implementation of the Electricity Integration Package.³¹⁰

Timeline: 2024-2026.

Responsible authorities/organizations: NEURC, VRU, CMU, JSC Market Operator

Description: To ensure regional interaction of TSOs and further integration of the balancing market of Ukraine with the markets of ENTSO-E countries for their integrated operation and real-time exchange of balancing electricity and capacity, the document provides for the definition of such European concepts as the region of operation of power systems (SOR)³¹¹ and the capacity calculation region (CCR),³¹² contractual relations between TSOs within the SOR and CCR regions, TSOs' involvement in the activities of the Regional Coordination Center (RCC), defining the role of the RCC in the electricity market and the tasks of the RCC, defining the list of European rules that are mandatory for Ukrainian electricity market participants, the list of regional rules and the procedure for their adoption, and defining the powers of ACER in the electricity market.

Gas market

PM_IMG_WEM_01 Measures in place to ensure sufficient natural gas production

³⁰⁹ <http://www.ukrainefacility.me.gov.ua/wp-content/uploads/2024/03/plan-ukraine-facility.pdf>

³¹⁰ <https://www.energy-community.org/implementation/package/EL.html>

³¹¹ SOR is a geographical region within which TSOs carry out operational and technological management of power systems.

³¹² CCR is a geographical region that includes the borders of the trade zones of neighboring countries for which the maximum possible volumes of electricity exports and imports are calculated in a coordinated manner.

Objective: to ensure natural gas production at the level of the ESU baseline scenario (21.5 billion m³ by 2030)

Legal basis: Law of Ukraine dated 18.09.2018 No. 2545-VI "On Ensuring Transparency in Extractive Industries", Law of Ukraine dated 15.03.2022 No. 2139-IX "On Amendments to the Tax Code of Ukraine and Some Other Legislative Acts of Ukraine on the Introduction of Differentiated Rent for Natural Gas Production", Law of Ukraine dated 20.09.2022 No. 2606-IX "On Amendments to Subsection 10 of Section XX "Transitional Provisions" of the Tax Code of Ukraine on Peculiarities of Taxation of Rent for Subsoil Use for Natural Gas Production", Law of Ukraine No. 2805-IX "On Amendments to Certain Legislative Acts of Ukraine on Supporting the Development of Domestic Subsoil Use Industries" dated 01.12.2022, Safety Rules in the Oil and Gas Industry approved by the Order of the Ministry of Economy dated 27.04.2023.

Timeline: 2024-2030 (ongoing)

Responsible authorities/organizations: Verkhovna Rada of Ukraine, Cabinet of Ministers of Ukraine, Ministry of Economy.

Description: In recent years, the following legislative measures have been taken to stimulate domestic natural gas production:

- differentiation of the royalty rate for new and old wells depending on the price level (up to \$150/thousand m³, from \$150 to \$400 and over \$400), with the state guaranteeing the unchanged royalty rate for "new wells" until 2032;
- defines the legal framework for regulating and organizing the 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;
- establishing by law the cases of granting special permits for subsoil use without an auction and on the basis of an auction, the grounds for amending them, extending their validity, as well as the grounds for refusing to grant and amend special permits and amending agreements on the terms of subsoil use, which are an integral part of special permits; based on this Law, the CMU adopted the Procedure for holding an auction (electronic bidding) for the sale of a special permit for subsoil use;
- the possibility of buying and selling subsoil use rights (special permits for subsoil use);
- the possibility of assessing mineral reserves according to international standards (in addition to the mandatory assessment according to national standards);
- digitalization of subsoil use and creation of the Unified State Information System for Subsoil Use;
- defines organizational and technical safety requirements for the design, drilling, construction and operation, overhaul and research of oil, gas and other wells related to oil and gas production, industrial and interfield oil and gas collection systems, preparation of oil and gas for transportation by main pipelines and for technological equipment of oil and gas production facilities that allows the use of Air Drilling technology.

In addition, for the period of the ban on natural gas exports, a deferral of royalty payments for volumes of gas produced but not sold was established, as well as special rules for determining the actual selling price to which royalty rates are applied.

PM_IMG_WAM_04 Additional measures to ensure sufficient natural gas production

Objective: to ensure natural gas production above the baseline scenario of the ESU, taking into account the analysis of the benefits and costs of subsidies to fossil fuel producers.

Legal basis: ESU

Timeframe: 2024-2030 (ongoing)

Responsible authorities/organizations: The Verkhovna Rada of Ukraine, the Cabinet of Ministers of Ukraine, the Ministry of Finance, the Ministry of Energy, the Ministry of Ecology, the Ministry of Internal Affairs/DSES.

Description: A number of additional measures are required to ensure natural gas production volumes above the baseline scenario of the ESU:

- demining of the de-occupied territory of Ukraine before mining activities;
- Increase transparency and predictability of the procedure for concluding and executing production sharing agreements through the adoption of the Draft Law of Ukraine No. 4344 "On Amendments to Certain Legislative Acts to Stimulate the Development of the Oil and Gas Industry".

In addition, further increase in natural gas production beyond the baseline scenario is possible through the development of new promising areas (Black Sea shelf, production in the unoccupied territories) or the use of new production methods (unconventional deposits). For this purpose, additional measures should be taken, as well as issues related to the requirements for operating pressures at the fields and the quality of natural gas supplied to the GTS (see a separate section) and the availability of equipment and technologies for production (see the dimension "Research, Innovation, Competitiveness").

While some policies and measures may have low marginal costs (e.g., administrative measures), others will require significant investments to generate new production volumes. Given that the implementation of additional measures leads to new production volumes only after at least 3-5 years, new investments in gas production, in particular if they involve public budget or public sector funds, should be compared in terms of the possibility of alternative use for more sustainable activities. In addition, even non-financial measures (e.g., granting land use rights) may in some cases limit opportunities for RES development. At the same time, it is possible that the sale of natural gas during the period of expected high prices (at the peak in 2035-2037) may be financially beneficial for the state, including for the purpose of further investing these funds in decarbonization.

According to the recommendations of the European Commission³¹³, the NEC 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 EU and global definition of energy subsidies. Ukraine currently has no policy to monitor, reduce and/or eliminate fossil fuel subsidies. All the different types of such subsidies should be properly systematized, described and controlled, taking into account the goals of the NECP.

PM_IMG_WAM_05 Opening of natural gas exports

Objective: to ensure unimpeded gas exports from Ukraine to the EU and the Energy Community

Legal basis: Article 41 of the Treaty establishing the Energy Community

Timeframe: 2025

³¹³ COM(2019) 285 final, 18.06.2019, p.14

Responsible authorities/organizations: Cabinet of Ministers of Ukraine, Ministry of Energy, Ministry of Finance

Description: In accordance with the Resolution of the Cabinet of Ministers of Ukraine dated December 27, 2023 No. 1402 "On Approval of the Lists of Goods, Export and Import of which are Subject to Licensing, and Quotas for 2024" (as amended), zero quota was approved for 2024 for Classification of Types of Economic Activities 2711 11 00 00, 2711 21 00 00 "Natural gas of Ukrainian origin".

In general, unimpeded export of energy products (including natural gas) is guaranteed by Article 41(1) of the Energy Community Treaty. Part two of this article allows for exceptions to this rule, in particular, for reasons of public security, provided that such exceptions cannot be a means of arbitrary discrimination or a disguised restriction on trade between states. In addition, the termination of the ban on natural gas exports is a prerequisite for exports to the EU, as envisaged by the ESU.

The main reason for the existing restrictions is public security, in particular security of natural gas supply. Since natural gas exports can have a positive effect on other aspects of energy markets, in 2025-2026, it is necessary to analyze alternative ways to ensure the security of natural gas supplies that would not harm natural gas exports to the EU and the Energy Community. At the same time, the search for alternative ways to solve the problem should be carried out taking into account the termination of natural gas transit from Russia through the territory of Ukraine.

One such way could be to strengthen control over the fulfillment of suppliers' obligations to supply natural gas to their consumers, even in crisis situations. The relevant obligations are set out in Article 5 of the Gas Market Law and the Rules on Security of Natural Gas Supply, which is in line with Regulation (EU) 2018/1938. However, the practice of their application, in particular at the beginning of the full-scale invasion in February-April 2022, shows the lack of effectiveness of these measures.

PM_IMG_WEM_02 Establishment of a technical security system in the gas market

Objective: to ensure state supervision over the technical aspects of the natural gas market, including households.

Legal basis: Articles 8, 8-1, part 3 of Article 18 of the Law of Ukraine "On the Natural Gas Market".

Timeline: 2024-2026

Responsible authorities/organizations: Verkhovna Rada of Ukraine, Cabinet of Ministers of Ukraine, Ministry of Energy, State Energy Supervision

Description: The Gas Market Law defines the competence of the Ministry of Energy in terms of:

- approval of technical and safety standards applicable to gas transmission and distribution systems, gas storage facilities, and 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 performing construction, engineering and technical works, and maintenance of gas transmission and distribution systems, gas storage facilities, and LNG installations (Article 8);
- establishing and approving requirements for the components of the natural gas metering unit, rules for the operation of metering devices, the procedure for measuring volumes and determining the quality of natural gas (part 3 of Article 18).

The main bylaw regulating these issues is the Gas Supply System Safety Rules approved by the Ministry of Energy prior to the enactment of this Law. At the same time, the acts of other state authorities (including the GTS, GDS and UGS Codes) contain separate provisions on technical issues. The Technical Regulation on Natural Gas has not yet been approved. Thus, there is currently a scattering of relevant regulations and no unified system of technical safety requirements (including requirements for the operation of networks and equipment, as well as interaction between natural gas market participants) at the state level.

In addition, for a long time, the Gas Market Law provided for the powers of the Ministry of Energy to formulate a technical safety policy (approval of the above rules), but not to implement (control) this policy. However, in July 2023, this Law was amended to define the term "state energy supervision (control)" and the powers of the state authority (the State Energy Supervision Service) to implement the relevant policy³¹⁴. Relevant amendments were made in early 2024 to the Regulation on the State Energy Supervision³¹⁵. In addition, a draft law is currently under consideration by the Parliament to clarify the powers of the Ministry of Energy and the State Agency on Energy Supervision in terms of ensuring technical safety³¹⁶.

Taking into account the adoption of this draft law in 2024, in 2024-2026, work should be done to adopt bylaws to implement the amendments, as well as to establish the institutional capacity of the State Agency for Energy Supervision, with further extension of technical supervision to the entire gas sector, which poses a threat to people, property and the environment. This work started in 2024 and is being carried out, among other things, with the help of a technical assistance project from the EU.

PM_IMG_WAM_06 Determination of optimal technical requirements for gas supply to networks

Objective: to balance the interests of gas infrastructure producers and operators for economically viable gas production/extraction.

Legal basis: NES, ESU

Timeline: 2024-2026

Responsible authorities/organizations: The Ministry of Energy, NEURC, GTSOU, gas producers.

Description: The technical issues of domestically produced natural gas supply to the GTS relate to maintaining gas quality parameters when it is supplied to the GTS and maintaining pressures at the field level.

In general, the GTSOU cooperates with gas producers under technical agreements, which specify, among other things, the pressure values, quality standards, physical and chemical parameters and other characteristics of natural gas at the points of acceptance and transmission. The GTSOU receives natural gas at the entry points from gas producers for further transportation, and the technological process of natural gas transportation through the GTSOU's main gas pipelines does not provide for processes for comprehensive preparation and change of the quality indicators of the transported gas.

According to GTS Operator of Ukraine LLC, the natural gas supplied to the GTS of Ukraine from gas producers contains CO2 in volumes that violate the requirements for the quality of gas supplied to the GTS. In addition, a significant number of entry points to the GTS receive natural gas that does not meet other requirements of the GTS Code in terms of the following indicators:

- dew point temperature by moisture,
- dew point temperature for hydrocarbons,

³¹⁴ <https://zakon.rada.gov.ua/laws/show/3293-20#n67>

³¹⁵ <https://zakon.rada.gov.ua/laws/show/1-2024-%D0%BF#n2>

³¹⁶ <https://itd.rada.gov.ua/billInfo/Bills/CardByRn?regNum=6133&conv=9>

- Higher calorific value.

The main violations are recorded in terms of dew point temperature, moisture and hydrocarbons of natural gas supplied to the GTS in summer. The dynamics of gas quality deterioration in the period from 2020 to 2023 is as follows:

- In 2020, between 6 and 16% of gas was supplied that did not meet the requirements of the GTS Code;
- In 2021, between 3% and 24% of gas was supplied that did not meet the requirements of the GTS Code;
- In 2022, between 6 and 33% of gas was supplied that did not meet the requirements of the GTS Code;
- In 2023, 11 to 67% of gas was supplied that did not meet the requirements of the GTS Code.

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 Ukrainian consumers, through interstate interconnection points and to underground gas storage facilities. Inconsistencies in gas quality lead to the accumulation of liquid (condensate) in the main gas pipelines, which creates prerequisites for pipeline corrosion, creates hydrate plugs, and increases the risk of failure of technological equipment at GDS and CS.

The issue of maintaining the pressure at the field level is the most relevant for JSC Ukrgasvydobuvannya given the significant depletion of the main part of its fields, as well as the historical chains of sales of produced gas to ensure the activities of the guaranteed supplier / fulfillment of special obligations in the natural gas market at a lower than market price.

Pressures at the field level of JSC Ukrgasvydobuvannya

Поточні тиски родовищ набагато нижчі за початкові рівні

Родовище	Рік	Тиск			Початкові запаси, млн м ³	Залишкові запаси, млн м ³
		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-Бачинське	1958	19	4	77%	49 566	2 453
Розлашнівське	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
Кепинівське	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
Ланіївське	1979	40	15	62%	12 809	4 838

Source: JSC Ukrgasvydobuvannya³¹⁷

The issue of maintaining gas quality when it is supplied to the GTS/UGS is also relevant to biomethane producers. Some GTS and UGS operators (Germany, Denmark, France) in the EU report on the problems that may arise when biomethane is supplied in increased volumes to existing gas networks, as well as on additional measures to be taken. It has already been found that as a result of a significant supply of biomethane, there is an increase in the content of oxygen, hydrogen, terpenes, cellophanes, ammonia, etc., and operators must take additional measures to transport gas from GDS to the GTS (reverse compressors) and de-odorize the gas coming from GDS to the GTS. At the same time, the Action Plan for the Implementation of Ukraine's Climate Policy as part of participation in the Global Methane Pledge initiative to reduce methane emissions provides for a proposal to update the requirements to set the maximum

³¹⁷ https://ugv.com.ua/uploads/UGV_Prez_16x9_ALL_Out3.pdf

standard value of the molar fraction of oxygen for biomethane at 0.5% (from the current value of 0.2% for the GTS).

In 2024-2026, it is necessary to determine the technical requirements for gas supply (natural gas, biomethane, and in the future - synethane methane and hydrogen) to the networks that are optimal in terms of the reliability of the GTS/GS and increase in production/production, as well as balanced in terms of the financial burden on the GTS/GS operator and producers, as well as effective control over their implementation.

PM_IMG_WEM_03 Switching to commercial gas metering in energy units

Objective: to ensure the use of energy units in settlements between natural gas market participants, in particular between GTSOs, DSOs and customers of their services

Legal basis: Law of Ukraine dated 02.11.2021 No. 1850-IX "On Amendments to Certain Laws of Ukraine on the Introduction of Metering and Settlement of Gas Volumes in Energy Units in the Natural Gas Market"

Timeline: 2024-2025

Responsible authorities/organizations: Ministry of Energy, Ministry of Finance, NEURC, gas infrastructure operators.

Description: The Law of Ukraine No. 1850-IX dated 02.11.2021 "On Amendments to Certain Laws of Ukraine on the Introduction of Metering and Settlements for Gas Volumes in Energy Units in the Natural Gas Market" provides for the use of energy units for natural gas metering. In July 2022, the date of entry into force of this Law was postponed to May 1, following the date of termination or abolition of martial law in Ukraine.

In the EU, natural gas is accounted for in energy units, both in relations between gas sellers and buyers and in relations with gas infrastructure operators. Metering gas in volume units creates obstacles to full integration into the EU energy markets, in particular in the case of customers using UGS facilities in the customs warehouse mode. In addition, this problem may be exacerbated by the need to enter information on the volume of biomethane produced into the EU's Union database.

During 2024-2025, the possibility of a full transition to energy unit metering (by amending the law accordingly) should be analyzed, or, alternatively, the transition to energy unit metering will be in relations where it is primarily necessary and where such implementation will not have a negative impact on the rest of the domestic market (for example, in relations with the transportation and storage of gas in the customs warehouse regime).

PM_IMG_WEM_04 Ensuring the attractiveness of Ukrainian oil and gas infrastructure for foreign customers

Objective: to increase the use of GTS and UGS capacities by customers from the EU, the Energy Community and other countries (which can be assessed depending on the increase in the number of customers, the increase in transportation/storage volumes or the increase in tariff revenues from such services)

Legal basis: ESU

Timeline: 2024-2030

Responsible authorities/organizations: Ministry of Energy, NEURC, Ministry of Foreign Affairs, GTSO, GTSO

Description: The ESU envisages the task of using tariff policy and creating new commercial products to further the use of Ukrainian gas infrastructure by EU customers.

In recent years, some new commercial products aimed at attracting new customers have been developed and are already in operation, namely the service of storing natural gas in Ukrainian UGS facilities in the customs warehouse mode, as well as short-distance transportation of natural gas through the GTS (short-haul). These services are in demand by customers from the EU and the Energy Community, even in the face of a full-scale invasion. The resilience of Ukrainian UGS facilities to risks was verified in the framework of stress tests conducted in 2022-2023 with the involvement of the European Commission, the Energy Community Secretariat, and the USAID Energy Security Project.

It is necessary to maintain competitive prices for the services of the GTS and the DSOs, as well as to stabilize tariffs during periods of uncertainty (for example, in 2024 and the first half of 2025). In addition, in the future, as part of optimizing the operation of gas infrastructure facilities, as well as taking into account the termination of gas transit from Russia to the EU in 2025, it is necessary to consider the possibility of developing additional commercial products. In addition, it is important to provide for the possibility of fulfilling the obligations of EU customers to store the mandatory volume of gas in Ukrainian UGS facilities, which requires amendments to EU law.

PM_IMG_WAM_07 Ensuring an effective timing control mode

Objective: to create a predictable legal regime for gas distribution activities and property of the GDS, which will increase the investment attractiveness of the OGSM

Legal basis: NES, ESU

Timeframe: 2024-2030

Responsible authorities/organizations: Verkhovna Rada of Ukraine, Cabinet of Ministers of Ukraine, Ministry of Energy, NEURC, governing bodies of the DSOs

Description: The NES envisages the introduction of incentive-based tariff setting in the gas market (a similar task is envisaged by the National Energy Efficiency Action Plan). The ESU identifies the need for modernization and effective management of the GDS. At the same time, both incentive-based tariff setting and the development or modernization of networks will not be successful unless the legal regime for relevant activities and property is predictable.

In 2022-2023, significant changes occurred in the management and operation of natural gas distribution activities. Based on a number of decisions of the state authorities and courts, the stakes in the GDS operators were transferred to the management of Chornomornaftogaz, a member of Naftogaz Group. Such management is temporary in nature, as it is intended for the period of seizure of these assets.

At the same time, another series of decisions authorized the conclusion of contracts for the operation of GDS and their components owned by the state and those on the balance sheet of NJSC Naftogaz of Ukraine with LLC Gas Distribution Networks of Ukraine and the termination of similar contracts with previous operators. This decision is also temporary, as the CMU Resolution No. 1335 of 25.11.2022 granted an exemption from the need to conclude lease agreements in accordance with the Procedure for the Lease of State and Municipal Property approved by the CMU Resolution No. 483 of 03.06.2020 for the period of

martial law in Ukraine and for five years after its termination or cancellation. Court appeals are currently pending in both areas.

At the same time, the Moratorium Law prohibits changes in natural gas distribution tariffs from the level of 2022. Draft Law 6133, which is being prepared for the second reading in the Parliament and is expected to be adopted in 2024, provides for limiting this ban to household consumers only.

This situation is not conducive to the creation of a predictable stable environment capable of attracting new investments of transparent foreign and domestic capital. Accordingly, in 2024-2029. The Ministry of Energy and the NEURC should develop and implement a comprehensive solution to this issue, including the following aspects: permanent legal regime of the property of the GDS, permanent legal regime of corporate rights of the DSOs, optimal business and operational model and, on its basis, optimal regulatory regime for all main activities of the DSOs (provision of gas distribution services, provision of connection services and changes to technical specifications, provision of services for maintenance of intra-building gas supply systems, etc.

PM_IMG_WAM_08 Setting up effective balancing rules

Objective: to ensure the functioning of the GTS balancing regime, which is economical and contributes to the creation of a short-term wholesale gas market

Legal basis: EU, Regulation (EU) 312/2014

Timeframe: 2024-2026

Responsible authorities/organizations: NEURC, Ministry of Energy, GTSOU

Description: The development of the short-term wholesale market is the main task of the balancing system established by Regulation (EU) 312/2014 (hereinafter - BAL NC), which is mandatory for Ukraine from the end of 2020. The implementation of the BAL NC in Ukraine began in 2016, and in 2017, the main amendments to the bylaws were adopted for this purpose. At the same time, the functioning of the balancing system in Ukraine is not in line with EU best practices, which is caused, among other things, by errors in the design of the balancing system in Ukraine.

ACER defines the following basic elements of balancing system design according to BAL NC:

- 1) Enabling measures are in place, namely: a virtual trading point has been created and imbalance trading via trade alerts is possible, the obligation to provide sufficient information to customers to balance on their own is fulfilled, and access to system flexibility is provided through the right to submit near real-time renominations;
- 2) The GTSOU has access to and uses a trading platform where short-term standardized products are available and used as the first priority for residual balancing by the TSO;
- 3) There is a daily imbalance closure at the end of each gas day, and the application of prices during the daily imbalance closure is not prevented by tolerances or other instruments;
- 4) The neutrality of the GTS operator's balancing activities is ensured, which means that customers receive refunds or pay additional funds to the GTS operator depending on the balance of the neutrality account, there is transparent reporting on neutrality, and funds related to neutrality are accounted for in different accounts compared to funds from tariffs;
- 5) Temporary measures, such as tolerances, a balancing platform, an alternative price (other than the market price) for daily imbalance closure, etc. are not applied.

For most of these design elements, the balancing system in Ukraine needs to be improved. For example, the information provided to customers for self-balancing is not sufficient. The GTSOU does not provide information on the state of the GTS, as required by BAL NC. Also, the BAL NC provision on the methodology for forecasting withdrawals that are not measured on a daily basis needs to be fully implemented. In particular, it is necessary to develop and publish such a methodology so that suppliers can familiarize themselves with it and, among other things, complain about its incorrect application. The use of balancing services is the main way of balancing, while BAL NC requires the use of short-term standardized products. While daily closing of customer imbalances is applied in principle, certain exceptions and instruments are used to limit its effect (e.g., under the PSO regime). Finally, the issue of balancing neutrality needs to be addressed separately.

During 2024-2026, work should be done to bring Ukraine's balancing system in line with the requirements of the BAL NC and the best practices of EU member states, taking into account the opportunities and limitations that exist in the context of a full-scale invasion.

iii. If applicable, measures to ensure non-discriminatory integration of renewable energy, demand side management and energy storage, including through aggregation, in all energy markets

Electricity market

Ukrainian legislation provides for the non-discriminatory integration of renewable energy production facilities into the electricity market and ensures their priority participation in the market.

PM_IME_WEM_07 Possibility for RES producers to choose the form of market participation and free transition between them

Objective: To facilitate the integration of RES-based generating capacities into the electricity market.

Legal basis: The Law of Ukraine "On the Electricity Market", the Law of Ukraine "On Amendments to Certain Laws of Ukraine on Restoration and Green Transformation of the Energy System of Ukraine".³¹⁸

Timeline: 2024 - 2029.

Responsible authorities/organizations: NEURC, VRU.

Description: RES electricity producers operating under the feed-in tariff have the opportunity to choose the form of their participation in the market. In particular, they can be part of the balancing group of the guaranteed buyer and operate under the feed-in tariff mechanism or sell electricity in competitive market segments (under bilateral agreements, the day-ahead market, intraday and balancing markets at prices prevailing in the respective segments) at free prices or under the market premium mechanism. RES producers can sell electricity independently or within balancing groups or use other forms of market participation (e.g., energy cooperatives, active consumers through self-production, aggregation (only RES generating units with a capacity of up to 20 MW), etc.).

PM_IME_WEM_08 Application of green electricity buyback guarantees

³¹⁸ <https://zakon.rada.gov.ua/laws/show/3220-20#Text>

Objective: To facilitate the integration of RES-based generating capacities into the electricity market.

Legal basis: The Law of Ukraine "On the Electricity Market", the Law of Ukraine "On Amendments to Certain Laws of Ukraine on Restoration and Green Transformation of the Energy System of Ukraine", the Law of Ukraine "On Alternative Energy Sources".

Timeframe: 2024 - 2029.

Responsible authorities/organizations: NEURC, VRU.

Description: The Guaranteed Buyer is obliged to purchase from renewable electricity producers operating under the feed-in tariff or who have acquired the right to support by auction all the electricity sold at electricity facilities or their construction phases (start-up complex) from alternative energy sources (and in the case of hydropower, only micro mini- and small hydropower plants), at the feed-in tariff established for them, the auction price, including a premium to it, for the entire period of application of the feed-in tariff or the term 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 to operate independently in competitive market segments at free prices, it is possible to return to the balancing group of the guaranteed buyer using the feed-in tariff mechanism.³¹⁹

According to the Law of Ukraine "On the Electricity Market" (Article 63), a universal service provider (USP) cannot refuse to conclude a power purchase agreement with a household and/or small non-household consumer that produces electricity from alternative energy sources and is located in the USP's territory of operation, provided that the consumer and the USP have concluded a power supply agreement. Accordingly, household and small non-household consumers (with a capacity of up to 50 kW), i.e. active consumers operating under the self-production mechanism, may sell to the LSE the surplus electricity generated by them from RES at hourly prices set on the DAM. Non-household consumers operating under the self-production mechanism can sell their surplus electricity to suppliers at contractual prices.³²⁰

PM_IME_WEM_09 Promoting non-discriminatory integration into the grid and the market for demand response, energy storage and aggregation

Objective: To create an institutional environment for the introduction of new models of participation in the electricity market in order to improve the sustainability and flexibility of the power system and the reliability of electricity supply to consumers.

Legal basis: The Law of Ukraine "On the Electricity Market", the Law of Ukraine "On Amendments to Certain Laws of Ukraine on Restoration and Green Transformation of the Energy System of Ukraine".

Timeframe: from 2024.

Responsible authorities/organizations: NEURC, VRU.

Description: The state policy in the electricity sector of Ukraine, among other things, is aimed at ensuring conditions and applying measures for the development of energy efficiency in the electricity sector, demand

³¹⁹ <https://zakon.rada.gov.ua/laws/show/2019-19#n2651>

³²⁰ <https://zakon.rada.gov.ua/laws/show/3220-IX#Text>

management; promoting electricity generation from alternative energy sources and the development of distributed generation and energy storage facilities.

The legislation provides that preference is given to investments aimed at improving energy efficiency and load management over investments in increasing generating capacity, if the former is a more efficient and cost-effective option, taking into account the positive impact on the environment as a result of reduced energy consumption and aspects related to security of supply and related distribution costs. In particular, the Government introduced the Procedure for holding a tender for the construction of generating capacity and the implementation of demand-side management measures.³²¹ In terms of demand management, the TSO, based on the report on the assessment of the adequacy (sufficiency) of generating capacities and the results of monitoring the security of electricity supply, submits to the Ministry of Energy conclusions and proposals on: 1) the need to hold tenders; 2) the scope of procurement of demand management measures; 3) the scope of impact on the electricity load schedule as a result of the implementation of demand management measures; 4) technical requirements, including technical characteristics of the equipment used to implement demand management measures.

When planning the development of the distribution system, distribution system operators (DSOs) should consider the need to build and/or reconstruct the distribution system to implement energy efficiency measures, demand management and/or the development of distributed generation and EMS.

Gas market

PM_IMG_WEM_05 Current measures to promote biomethane production

Goal: to achieve biomethane production of 100 million m³/year by 2030

Legal basis: Part 1 of Article 19 of the Gas Market Law, the Law of Ukraine "On Alternative Fuels", the Law of Ukraine dated 09.08.2023 No. 3311-IX "On Amendments to Certain Legislative Acts of Ukraine on the Implementation of Investment Projects with Significant Investments", the Procedure for the Functioning of the Biomethane Register approved by the Resolution of the Cabinet of Ministers of Ukraine dated 22.07.2022 No. 823, the GTS Code, the GDS Code, the DSTU EN 16723-1:2023 standard

Timeframe: 2024-2030

Responsible authorities/organizations: Verkhovna Rada of Ukraine, Cabinet of Ministers of Ukraine, NEURC, Ministry of Energy, State Agency on Energy Efficiency and Energy Saving

Description: In recent years, the following measures have been taken to promote biomethane production:

- The legal right to access and connect to gas networks:

According to Article 19(1) of the Law of Ukraine "On the Natural Gas Market", producers of biogas or other types of gas from alternative sources have the right to access gas transportation and gas distribution systems, gas storage facilities, LNG facilities, subject to compliance with technical and safety requirements in accordance with the law and provided that biogas or other types of gas from alternative sources comply with the regulations on natural gas in terms of their physical and chemical characteristics. In addition, it is stated that the provisions of this Law on natural gas are applied on a non-discriminatory basis to biogas or

³²¹ <https://zakon.rada.gov.ua/laws/show/677-2019-%D0%BF#Text>

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, and LNG facilities. The GTS Code clearly applies this provision to biomethane producers.

- Relief of gas quality requirements for biomethane supply:

The supply of biomethane to the GTS has been simplified by increasing the permissible oxygen content in the gas supplied to the GTS and GDS to 0.2 mol% for the GTS and 1% for the GDS. In general, this level is within the average value in the EU and the Energy Community³²².

- Approval of a standard for biomethane:

Order No. 55 of the State Enterprise "Ukrainian Research and Training Center for Standardization, Certification and Quality" dated 03.04.2023 adopted the DSTU EN 16723-1:2023 standard for natural gas and biomethane for use in transport and biomethane for injection into the natural gas network.

- Legal prerequisites for reverse gas flow between the GTS and the GDS:

Clarifies the conditions for connecting biomethane plants to the networks of GTS and GDS operators, in particular, introduces the concepts of "biomethane" and "reverse compressor station", and establishes the specifics of connecting this group of customers.

- Promoting large-scale biomethane production projects;³²³
- Provision for the creation of a biomethane register, guarantees and certificates of origin of biomethane:

The Law of Ukraine of 21.10.2021 No. 1820-IX "On Amendments to Certain Laws of Ukraine on the Development of Biomethane Production"³²⁴ and the Law of Ukraine of 30.06.2023 No. 3220-IX "On Amendments to Certain Laws of Ukraine on the Restoration and Green Transformation of the Energy System of Ukraine" :³²⁵

The Law defines biomethane as a gas that complies with the regulatory acts on natural gas for supply to gas networks or for use as a motor fuel;

the concepts of a guarantee of biomethane origin and a certificate of biomethane origin are defined;

The law provides for the existence of a register of biomethane (both supplied to gas networks and liquefied or compressed biomethane) and the procedures and powers for its creation and operation.

In particular, it is stipulated that an account in the biomethane register shall be created after an independent audit of the biomethane production facility confirming its ability to produce biomethane and is regulated by the Procedure for the Functioning of the Biomethane Register. Simultaneously with the revocation of the biomethane origin guarantee, a certificate of origin of biomethane is formed, and these procedures should be regulated by an international agreement on the interaction of registers in the case of biomethane exports. In pursuance of this Law, the CMU Resolution No. 823 of 22.07.2022 approved the Procedure for the Functioning of the Biomethane Register. However, as of April 2024, the biomethane registry has not been launched, and therefore, no relevant guarantees of origin are issued.

The State Agency on Energy Efficiency and Energy Saving has been an observer in the Association of Issuing Authorities since 2022.

- Launch of biomethane exports to the EU:

³²² CEER-ECRB Benchmarking Report on the Quality of Electricity and Gas Supply, p. 297.

³²³ <https://zakon.rada.gov.ua/laws/show/3311-20#Text>

³²⁴ <https://zakon.rada.gov.ua/laws/show/1820-20#n39>

³²⁵ <https://zakon.rada.gov.ua/laws/show/3220-IX#Text>

20.03.2024 Draft Law of Ukraine Draft Law on Amendments to the Customs Code of Ukraine on Customs Clearance of Biomethane³²⁶. It should unblock the export of biomethane from Ukraine. To implement its provisions, it is necessary to amend certain acts of the Ministry of Finance. These measures should be taken in 2024.

PM_IMG_WAM_09 Additional measures to promote biomethane production

Goal: to achieve biomethane production of 1 billion m3/year by 2030

Legal basis: ESU, Action Plan for the Implementation of the Climate Policy of Ukraine within the framework of participation in the Global Methane Pledge, a global initiative to reduce methane emissions

Timeline: 2024-2030

Responsible authorities/organizations: Ministry of Energy, State Agency on Energy Efficiency and Energy Saving, NEURC, Ministry of Foreign Affairs, Ministry of Economy

Description: According to information received during public consultations, existing policies and measures can stimulate biomethane production at the level of 50-100 million m3/year by 2030³²⁷. These volumes are significantly lower than the announced potential of biomethane production in Ukraine, as well as the goals of other countries with a similar base for the development of the industry (France - 4 billion m3, the Netherlands - 2 billion m3) declared for 2030. Thus, according to the Bioenergy Association of Ukraine, under an optimistic scenario, Ukraine can reach 1 billion m3/year of biomethane production by 2030, distributed in a 50/50 ratio between domestic consumption and exports. Additional measures are needed to increase production volumes (taking into account the sustainability criteria in force in the EU and to be implemented in Ukraine):

- Establish a biomethane traceability system integrated with the EU, eliminating double counting of biomethane exported to the EU:

From the end of 2024, the EU will launch the Union database (UDB) for gas-compatible biofuels. The condition for competitive sales of biomethane from Ukraine to the EU is the accession of Ukrainian producers to the UDB, as well as the adoption of measures in Ukraine that will allow the use of voluntary support schemes recognized by the European Commission to monitor the origin of biomethane, its movement and sources, as well as eliminate the possibility of simultaneously taking into account the results of production for reporting purposes in Ukraine and in EU member states that will import Ukrainian biomethane. During 2024, the Ministry of Energy, together with other government agencies, should work to identify the measures required by Ukraine and ensure their implementation.

- Create a system of guarantees of origin in the domestic market and ensure their recognition in the EU:

It is commercially feasible to export biomethane from Ukraine to the EU without guarantees of origin issued by Ukrainian authorities. However, the system of guarantees of origin should create conditions for increasing demand for biomethane in the domestic market, as well as for the possibility of further introducing a mandatory share of biomethane in gas supply/consumption.

The Biomethane Register should be launched in 2024-2025. During 2025-2029, measures should be developed and implemented to launch a system of guarantees of origin within the country.

³²⁶ <https://itd.rada.gov.ua/billInfo/Bills/Card/42226>

³²⁷ Public consultations held on December 13, 2023.

In addition, the recognition of guarantees of origin issued by Ukrainian authorities in the EU may further increase the competitiveness of Ukrainian biomethane. Recognition of Ukrainian biomethane guarantees of origin in the EU requires the conclusion of a relevant agreement with the EU and the availability of a commensurate system of guarantees of origin. The relevant agreement can be reached as part of the amendments to the Energy Community Treaty. In addition, the recognition of guarantees of origin requires cooperation of the relevant authorities within specialized organizations, such as the Association of Issuing Authorities (AIA) or ERGaR. The State Agency on Energy Efficiency and Energy Saving has observer status in the Association of Issuing Authorities since 2022.

- Launch of an organized market for solid biofuels:

The ESU notes the need to create a legislative framework for the development of trade in solid biological fuels, which consists in creating a biomass market and developing regulations to govern its activities.

- Access to funding from the Decarbonization Fund;
- Financial support for small biomethane producers:

The Law of Ukraine No. 3311-IX of 09.08.2023 "On Amendments to Certain Legislative Acts of Ukraine on the Implementation of Investment Projects with Significant Investments"³²⁸ provides for support for significant biomethane production projects. At the same time, public consultations revealed that the main biomethane producers are small-scale producers (up to 3 million m³/year), while large-scale producers are large companies that are potentially able to raise capital on favorable terms. Thus, the support allocated to large biomethane producers could be revised to distribute it to small enterprises. For example, the Action Plan for the Implementation of the Climate Policy of Ukraine as part of participation in the Global Methane Pledge initiative to reduce methane emissions provides for partial reimbursement of the cost of facilities (up to 50 percent of the cost, and up to 70 percent of the cost for agricultural cooperatives) for processing animal by-products of categories II and III, as well as reducing the cost of construction of livestock complexes with biogas plants for the production of biomethane for dairy farming.

- Simplifying the conditions for connecting to gas networks (in terms of time and cost of connection):

The ESU provides for a measure to simplify the connection of biomethane producers to gas networks, but does not detail this measure sufficiently. During the public consultations, market participants voiced that a significant problem for the development of the biomethane market is the "arbitrariness" of the DSOs (given that biomethane producers are often also electricity producers). The specific problems voiced relate to the time and costs of connecting to the grid.

In the context of time, it is possible to consider various options for regulatory incentives to reduce the timeframe for issuing technical conditions for connection or to use the principle of tacit consent for connection. Another approach could be to use existing research, in particular the creation of "renewable go-to zones" based on zoning, which has already been conducted by the NGO Bioenergy Association of Ukraine (UABIO) with the support of the EBRD³²⁹.

In the context of connection costs, it is possible to consider a significant reduction or at least stabilization of connection costs, in particular for small producers (up to 3 million m³/year), given that the GTSO and the DSO will benefit from the transportation/distribution of gas from these producers in the future. In general, in the EU countries, the costs of connecting biomethane activities can be covered by the respective operator by 60-75% (France, Germany).

One option (similar to Germany) could be to set a cap on the amount of connection fees that can be paid by the customer in case of connection at a certain distance from the existing grid, with the rest of the costs covered by the respective operator. This approach creates predictability of costs for the investor, while the

³²⁸ <https://zakon.rada.gov.ua/laws/show/3311-20#Text>

³²⁹ <https://saf.org.ua/wp-content/uploads/2022/02/BM-Zoning-Final-Report-version-2022-02-01.pdf>

operator is incentivized to reduce the costs of overcoming obstacles to connection. To cover the remaining costs of the GTS/TRS operator, given the current deficit of the GTS operator's tariff in the second regulatory period, as well as the obstacles to the introduction of RAB tariff setting at the level of the DSO, a separate financing program may be developed with the participation of the state budget or international partners.

In addition, it is necessary to build mutual understanding between investors and GDS operators: holding joint seminars to explain the existing rules and develop proposals for improving the regulatory framework, the important role of the Ministry of Energy/NEPURC as a mediator in this process, and, if necessary, creating an electronic window for submitting documents for connection, which can both improve the process of uploading and processing the package of documents and strengthen the control of the NEURC over the process;

- Revision of the approach to legal regulation of reverse compressor stations:

The decision to finance the installation of reverse compressor stations, enshrined in NEURC Resolution No. 1021 of 08.06.2023, needs to be further refined in view of the goal of developing a competitive market and preventing the creation of conditions for monopolistic abuse of access to important infrastructure. The current regulation creates a situation where one biomethane producer can create an infrastructure facility that other producers - its competitors - will need to access in the future. According to EU practice, reverse compressors are owned by gas transmission companies (Denmark, Austria).

iv. Policies and measures to protect consumers, especially vulnerable and, where applicable, energy poor consumers, and to increase the competitiveness and affordability of the retail energy market

PM_IM_WAM_03 Ensuring the independence of the NEURC

Objective: to provide an institutional environment for balancing the interests of various market participants and the state

Legal basis: Plan for Ukraine Facility 2024-2027³³⁰

Timeframe: 2024-2025

Responsible authorities/organizations: Verkhovna Rada of Ukraine, Cabinet of Ministers of Ukraine

Description: In 2023. In a special report, the Energy Community Secretariat noted certain shortcomings and the need to strengthen the NEURC's institutional independence³³¹, and the Regulator itself developed an Action Plan to ensure its independence in accordance with Ukraine's international obligations³³², which, together with a letter of justification, was sent to the Cabinet of Ministers of Ukraine.

In order to achieve compliance with the requirements of the Energy Community acquis on the status, independence and tasks of national energy regulators, the following measures should be taken:

- by the 4th quarter of 2024 - amendments to the Law of Ukraine dated 24.08.2023 No. 3354-IX "On Lawmaking", which will exempt the NEURC's decisions, which are regulatory legal acts, from the state registration procedure;

³³⁰ <http://www.ukrainefacility.me.gov.ua/wp-content/uploads/2024/03/plan-ukraine-facility.pdf>

³³¹ <https://www.energy-community.org/news/Energy-Community-News/2023/10/20b.html>

³³² <https://www.nerc.gov.ua/news/sekretariat-energetichnogo-spivtovaristva-nagoloshuye-na-neobhidnosti-posiliti-institucijnu-nezalezhnist-regulyatora>

- by the 4th quarter of 2025 - amendments to the Law on the NEURC and other acts that will provide for the determination of a special status to ensure the independence of the Regulator based on a roadmap developed by the Ministry of Energy and agreed with the Energy Community Secretariat;
- to appoint the NEURC members from among the candidates selected through an open and professional competition.

PM_IM_WEM_02 Targeted monetized subsidies for partial compensation of energy services

Objective: *to support those households whose energy costs are excessive compared to their income*

Legal basis: Regulation on the Procedure for Awarding Housing Subsidies, approved by the CMU Resolution No. 848 of 21.10.1995, Plan for Ukraine Facility 2024-2027

Timeline: 2024-2026

Responsible authorities/organizations: Cabinet of Ministers of Ukraine, Ministry of Social Policy, Ministry of Energy, NEURC

Description: Ukraine has switched from indirect subsidies to non-cash monetized subsidies for households to reimburse the cost of electricity, gas, heat and other utilities. Payments for energy and other utilities that exceed a certain threshold as a share of average monthly household income are covered by subsidies³³³.

At the same time, the Ukraine Facility 2024-2027 Plan for the 2nd quarter of 2026 requires the Ministry of Energy and the NEURC to prepare a roadmap for the gradual liberalization of the gas and electricity markets and the CMU to approve it. Mandatory elements of this roadmap should include the construction of a new subsidy system for vulnerable consumers that improves targeting and ensures an adequate level of protection, as well as preparatory steps to be implemented before the end of martial law, such as the identification of vulnerable groups and a related digital solution.

PM_IM_WAM_04 Institutional support for the protection of vulnerable consumers

Goal: *to create a system for identifying and supporting certain categories of consumers*

Legal basis: Article 16 of the Law of Ukraine "On the Natural Gas Market", Article 61 of the Law of Ukraine "On the Electricity Market"

Timeline: 2024-2026

Responsible authorities/organizations: Cabinet of Ministers of Ukraine, Ministry of Energy, NEURC, Ministry of Social Policy

Description: The Law of Ukraine "On the Natural Gas Market" (Article 16) defines vulnerable consumers as household consumers who are entitled to state aid in accordance with the procedure established by the Cabinet of Ministers of Ukraine, which, in particular, sets out the criteria for classifying consumers as vulnerable. Vulnerable consumers are entitled to a subsidy for reimbursement of expenses for consumed natural gas and other targeted assistance provided in accordance with the procedure established by the

³³³ <https://zakon.rada.gov.ua/laws/show/848-95-%D0%BF#Text>

Cabinet of Ministers of Ukraine, as well as to special measures to protect vulnerable consumers in relation to disconnection during critical periods in order to meet the needs of such consumers in natural gas.

The Law of Ukraine "On the Electricity Market" (Article 61) stipulates that vulnerable consumers are entitled to support provided by law to reimburse the costs of paying for the consumed electricity in accordance with the procedure established by the Cabinet of Ministers of Ukraine.

Procedures for protecting vulnerable gas and electricity consumers have not been approved as of April 2024. Their development and approval should be coordinated and are part of the roadmap for the gradual liberalization of gas and electricity markets, as provided for in the Plan for Ukraine Facility 2024-2027, with a deadline of Q2 2026.

PM_IM_WAM_05 Application of online services for consumers (eConsumer)

Goal: to create a convenient and useful digital solution for submitting and receiving information on gas and electricity consumption

Legal basis: ESU

Timeframe: 2024-2026

Responsible authorities/organizations: Ministry of Energy, NEURC, Ministry of Digital Transformation

Description: The ESU envisages the creation of an energy consumer's account - eConsumer - which will use information from data hubs and other sources of information to enable consumers to receive useful information, identify inconsistencies, and exercise their other rights provided for by law (change of supplier, etc.). This digital solution is part of the roadmap for the gradual liberalization of the gas and electricity markets, as envisaged in the Ukraine Facility 2024-2027 Plan, with a deadline of Q2 2026.

PM_IM_WEM_03 Regulation and liberalization of retail energy prices

Objective: to ensure the gradual introduction of market-based energy pricing

Legal basis: Law of Ukraine No. 2479-IX dated 27.07.2023 "On Peculiarities of Regulation of Relations in the Natural Gas Market and in the Heat Supply Sector during Martial Law and Further Restoration of Their Functioning", Resolution of the Cabinet of Ministers of Ukraine No. 483 dated June 5, 2019 "On Approval of the Regulation on the Imposition of Special Obligations on Electricity Market Participants to Ensure Public Interests in the Process of Electricity Market Functioning".

Timeframe: 2024-2026

Responsible authorities/organizations: Cabinet of Ministers of Ukraine, Ministry of Energy, NEURC

Description: In addition to directly supporting household consumers through subsidies, Ukraine maintains relatively low regulated prices for natural gas and electricity.

The Law of Ukraine No. 2479-IX of 27.07.2023 "On Peculiarities of Regulation of Relations in the Natural Gas Market and in the Heat Supply Sector during the Martial Law and Further Restoration of Their

"Functioning" stipulates that during the martial law in Ukraine and six months after the month in which the martial law is terminated or lifted, the price of natural gas for household consumers, as well as for certain related categories of consumers, shall not be subject to an increase from the price applied in the relations between suppliers and the respective consumers as of 24

The electricity market has a corresponding PSO mechanism³³⁴. In the natural gas market, PSO mechanisms are in place, which define the terms of gas supply to other categories of consumers, except for households.

These measures pose significant obstacles to the development of a competitive gas market, as they limit price formation through the action of supply and demand forces, and are temporary. At the same time, it is envisaged to maintain time-differentiated electricity prices for households (depending on the time of day) (for more details, see Section 3.4.3.v).

The Ukraine Facility 2024-2027 Plan for the 2nd quarter of 2026 requires the Ministry of Energy and the NEURC to prepare a roadmap for the gradual liberalization of the gas and electricity markets and the CMU to approve it. This roadmap should include the steps necessary to reform PSO to gradually liberalize market prices after the lifting of martial law, taking into account technical analysis to understand the financial condition of the sector.

PM_IM_WEM_04 Provider of last resort / universal service provider

Objective: to ensure the reliability and uninterrupted supply of electricity and gas to consumers

Legal basis: Article 15 of the Law of Ukraine "On the Natural Gas Market", Articles 63, 64 of the Law of Ukraine "On the Electricity Market".

Timeline: 2024-2030 (ongoing)

Responsible authorities/organizations: Cabinet of Ministers of Ukraine, NEURC

Description: The Gas Market Law stipulates that in certain cases and for a limited period of time, natural gas is supplied to consumers by the supplier of last resort on the terms and conditions determined by the Regulator. These cases relate to situations where the consumer was left without a supplier through no fault of the consumer. The "last resort" supplier is determined by the CMU for a period of three years based on the results of a tender held in accordance with the procedure established by the CMU. For the period of martial law and within 6 months after its termination or cancellation, the supplier of last resort is appointed without a tender. The CMU Resolution No. 793-r dated 12.09.2023 designated Gas Supply Company Naftogaz of Ukraine LLC as the supplier of last resort for this period. At the same time, the PSO Regulations approved by the CMU Resolution No. 222 of 06.03.2022 impose special obligations on the supplier of last resort to supply gas to certain categories of consumers.

The supplier of last resort (SoLR) in the electricity market provides electricity supply services to consumers in the cases specified by the Law of Ukraine "On the Electricity Market" (Article 64). The SoLR is determined by a decision of the Cabinet of Ministers of Ukraine based on the results of a tender. The SoLR supplies electricity to consumers at a price formed in accordance with the methodology (procedure) approved by the Regulator.

³³⁴ <https://zakon.rada.gov.ua/laws/show/483-2019-%D0%BF#Text>

In addition, the electricity market provides for the function of a universal service provider. The universal service provider cannot refuse to conclude an electricity supply agreement with a household and/or small non-household consumer located in the territory of its operations, which will guarantee the possibility for household and small non-household consumers to receive electricity supply services.

In 2025-2026, inconsistencies between the status of the supplier of last resort under the law and its actual status and tasks in the market should be eliminated. The function of the supplier of last resort should not be used to supply beyond a specified short period or to consumers who have been left without a supplier through the fault of the consumer. Other safeguards should be in place to ensure the reliability and continuity of supply to these customers.

PM_IM_WEM_05 Ensuring consumer access to important information

Objective: to protect consumer rights, increase consumer participation in the market

Legal basis: Articles 12, 40 of the Law of Ukraine "On the Natural Gas Market", the Law of Ukraine "On the Electricity Market", the Rules for the Supply of Natural Gas, the Rules of the Retail Electricity Market.

Timeframe: 2024-2030 (ongoing)

Responsible authorities/organizations: NEURC, suppliers, DSOs, TSOs

Description: Consumers (including household consumers) have the right to receive information that is important to them. Suppliers and DSOs are obliged to place such information on the payment documents (bills) they issue to consumers, in the consumer's personal accounts and on the supplier's/dispayer's website. The information to be posted relates to general terms and conditions of supply and contractual terms, prices, means of filing complaints and claims, change of supplier, etc.

PM_IM_WEM_06 Use of tools to facilitate comparison of commercial offers and consumer choice

Goal: to increase consumer participation in the market

Legal basis: -

Timeframe: 2025-2026

Responsible authorities/organizations: NEURC

Description: In Ukraine, there are independent tools (online services) to facilitate the comparison of price offers of electricity suppliers and the consumer's decision to choose or change suppliers³³⁵. Similar tools are available in the natural gas market: for example, the Gazoteka service from DiXi Group³³⁶ and the GazPravda consumer advisory center from the All-Ukrainian Industry Association Federation of Oil and Gas Employers³³⁷.

³³⁵ <https://rep.oree.com.ua/index.php?route=product/category&path=115>

³³⁶ https://gasoteka.ua-energy.org/?_ga=2.96846620.2046844725.1696501319-501792254.1693297960

³³⁷ <https://gazpravda.com.ua/pro-tsentr>

Additional measures are in place in the electricity market. In order to improve the availability of information on available commercial offers of suppliers to consumers, the Regulator acts as an aggregator of public commercial offers and publishes relevant links on its website³³⁸. To indirectly stimulate competition, the Regulator uses a rating tool and publishes a rating of companies based on the quality of electricity supply³³⁹. The rating covers the assessment of the activities of distribution system operators (DSOs) and universal service providers (USPs) for 2021 and 2022. The analysis covers indicators of electricity supply reliability (the average duration of interruptions in electricity supply index - SAIDI; the target reduction of SAIDI is one of the essential conditions for RAB regulation of DSOs) and commercial quality of service (the average time for responding to a customer's request/complaint/claim, the level of call center service within 30 seconds, and the percentage of call center calls lost in the queue).

In 2025-2026, the requirements of the EU/EU Energy Community acquis on the operation of tools to facilitate the comparison of commercial offers should be implemented, in particular, in the electricity and natural gas markets, there is a publicly available tool for comparing commercial offers, it meets the specified requirements and constantly complies with them and has received confirmation of compliance from the authorized state body.

PM_IM_WEM_07 Simplified procedure for changing the supplier

Objective: to ensure that consumers benefit from the liberalization of energy markets

Legal basis: Article 14 of the Law of Ukraine "On the Natural Gas Market"; Article 59 of the Law of Ukraine "On the Electricity Market"

Timeline: 2025-2026

Responsible authorities/organizations: NEURC

Description: The procedure for changing suppliers in the natural gas and electricity markets is similar, and should guarantee the consumer's right to change suppliers and ensure that the procedure for changing suppliers is quick and convenient. This procedure contains the following requirements:

- The terms of the supply agreement may not restrict the consumer's right to change the supplier.
- The change of supplier is free of charge. In general, no fee or other compensation may be charged for changing suppliers.
- The change of supplier at the initiative of the consumer must be completed within three weeks from the date of notification of the consumer's intention to change the supplier.

In the electricity market, at the request of the consumer, the change of supplier must be completed under the shortened rule within 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 forecast data on meter readings as of the date of the change of supplier). In the natural gas market, in practice, the procedure takes even shorter time, due to the fact that the actual meter readings are not taken during this procedure.

³³⁸ <https://www.nerc.gov.ua/sferi-diyalnosti/elektroenergiya/publichni-komercijni-propoziciyi/publichni-komercijni-propoziciyiyi>

³³⁹ <https://www.nerc.gov.ua/news/nkrekp-publikuye-rejting-kompanij-za-pokaznikami-yakosti-elektropostachannya>

From a technical point of view, the process of changing the supplier in the electricity market is organized through the central information and telecommunication platform DataHub, which contains a centralized register of commercial metering points (CMPs)³⁴⁰. In the natural gas market, similar functions are performed by the GTSOU information platform, although it does not provide data storage for consumer identification and location of consumption facilities (for this purpose, a DataHub in the natural gas market should be created).

During 2025-2026, in parallel with the creation of the DataHub in the natural gas market, the procedure for changing suppliers in both markets should be analyzed and, if necessary, adjusted in accordance with the requirements of the EU/EU acquis. For example, in the natural gas market, it is important to address the problem of so-called "negative allocations" that arise when a supplier changes for a number of reasons, including the lack of consideration of actual consumption data in the previous supplier's portfolio.

PM_IM_WEM_08 Development of organized wholesale energy markets

Goal: to reduce the cost of energy supply to consumers through functioning wholesale markets

Legal basis: Law of Ukraine "On Capital Markets and Organized Commodity Markets"; Law of Ukraine "On Commodity Exchanges"; Law of Ukraine "On Amendments to Certain Laws of Ukraine on Prevention of Abuse in Wholesale Energy Markets"; Plan for Ukraine Facility 2024-2027³⁴¹

Timeline: 2024-2026

Responsible authorities/organizations: NEURC, National Securities and Stock Market Commission (NSSMC), Antimonopoly Committee of Ukraine, Ministry of Energy

Description: The Laws of Ukraine "On Capital Markets and Organized Commodity Markets" and "On Commodity Exchanges" in the new version of the Law of Ukraine No. 738-IX dated 19.06.2020 lay the foundation for the creation of organized wholesale markets in Ukraine according to the European model, including energy markets. It provides for updated powers for state authorities and requirements for operators of such markets, including the concept of clearing. Thus, the activities of commodity exchanges are subject to licensing by the NSSMC. As of April 2024, 4 commodity exchanges have the relevant licenses.

Additional measures have been taken to further develop wholesale energy markets:

- Implementation of the REMIT Regulation:

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, in particular, introduces mandatory registration of electricity and natural gas market participants operating or intending to operate in the wholesale energy market, as well as other measures to promote integrity and transparency in the wholesale energy market.

In accordance with the Ukraine Facility 2024-2027 Plan, by Q3 2024, the NEURC will approve: the procedure for acquiring, suspending and terminating the status of data transmission administrator; the procedure for the operation of insider information platforms; requirements for ensuring integrity and transparency in the wholesale energy market; the procedure for submitting information on economic and

³⁴⁰ <https://ua.energy/databus/>

³⁴¹ <http://www.ukrainefacility.me.gov.ua/wp-content/uploads/2024/03/plan-ukraine-facility.pdf>

trade operations with wholesale energy products. In addition, the NEURC will ensure the registration of wholesale energy market participants and prepare the Terms of Reference for the development of an information system to ensure the performance of the NEURC's functions. Subsequently, the IT system will be developed and put into operation.

- Interaction between regulatory authorities:

On 03.04.2024, the NSSMC and the NEURC signed an Agreement on Interaction and Cooperation, which will allow coordinating regulatory supervision of wholesale energy markets in accordance with EU best practices.

- International cooperation:

The SEEGAS initiative, which brings together representatives of southeastern and eastern Europe (including Ukraine) with the support of the Energy Community Secretariat and the EBRD, is working to create an efficient clearing system for gas and related derivatives.

It should also be noted that the decision of 24.12.2020 No. 811-p, adopted in the framework of the case on obtaining a permit for concentration in the form of acquisition by NJSC Naftogaz of Ukraine of a share in the authorized capital of LLC Nadra Yuzivska, the Antimonopoly Committee of Ukraine (AMCU) obliged Naftogaz Group to ensure a competitive sale offer after the concentration, namely on commodity exchanges, natural gas in the amount of at least 15 percent of the total volume of commercial gas produced during the year by Naftogaz Group's business entities (except for PJSC Ukrnafta), excluding gas sales under JI.

During 2025-2026, the Ministry of Energy, together with the NEURC, the NSSMC and the Antimonopoly Committee of Ukraine, should consider the need to take additional measures to increase the liquidity of organized wholesale markets, in particular the electricity and natural gas markets, taking into account the state of development of the infrastructure of organized wholesale markets, as well as consultations with market participants. Liquidity in the electricity market should be ensured through the development of exchange trading in standardized energy products. Liquidity in the gas market should be created both by attracting an additional resource that should be traded on organized markets and by sufficient demand for this additional resource from buyers who are ready and able to work in these markets. In addition, organized markets should have mechanisms in place to make exchange trading attractive to trading participants, including reducing the risks of default on the part of customers, and protecting against price manipulation.

Electricity market

PM_IME_WEM_10 Application of service quality standards and provision of compensation to consumers for non-compliance

Objective: To improve the quality of electricity supply services and protect consumer rights.

Legal basis: NEURC Resolutions No. 373 "On Approval of the Minimum Requirements for the Quality of Electricity Consumers' Service by Call Centers" dated 12.06.2018 and No. 375 "On Approval of the Procedure for Ensuring the Quality Standards of Electricity Supply and Providing Compensation to Consumers for Non-Compliance".

Timeline: since 2018.

Responsible authorities/organizations: NEURC.

Description: In order to protect consumer rights, the Regulator approved the Procedure for Ensuring Quality Standards for Electricity Supply and Providing Compensation to Consumers for Non-Compliance (defines quality standards for the services of the TSO, DSO and supplier),³⁴², as well as the Minimum Requirements for the Quality of Electricity Consumer Service by Call Centers.³⁴³ The said Procedure, in particular, establishes the amount of compensation for non-compliance with the guaranteed quality standards for the provision of services by the DSO and the electricity supplier. The Rules of the Retail Electricity Market define the procedure for retail market participants to act when considering consumer requests, complaints and claims.

For its part, the Regulator monitors compliance by electricity suppliers and DSOs with general and guaranteed service quality standards and the amount of compensation provided for non-compliance with guaranteed service quality standards by analyzing the relevant reports regularly submitted by licensees.

PM_IME_WEM_11 Electricity supply to protected consumers

Objective: To ensure reliable supply of electricity to certain categories of consumers.

Legal basis: The Law of Ukraine "On the Electricity Market".

Timeline: since 2018.

Responsible authorities/organizations: CMU.

Description: The Law of Ukraine "On the Electricity Market" (Article 60) identifies 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 man-made emergencies. The disconnection of protected consumers is carried out in compliance with the requirements of the Procedure for Ensuring the Supply of Electricity to Protected Consumers approved by the CMU, which defines: 1) the procedure for compiling a list of protected consumers; 2) the procedure for limiting or disconnecting electricity supply to protected consumers; 3) mechanisms for ensuring full current payment by protected electricity consumers by providing advance payment for the projected consumption and/or providing a financial guarantee of payment or in another way.³⁴⁴

Gas market

PM_IMG_WEM_06 Basic annual offer of the natural gas supplier

Objective: to ensure the development of new products from suppliers

Legal basis: Rules for the supply of natural gas, Standard contract for the supply of natural gas to household consumers

³⁴² <https://zakon.rada.gov.ua/laws/show/v0375874-18#Text>

³⁴³ <https://zakon.rada.gov.ua/laws/show/v0373874-18#Text>

³⁴⁴ <https://zakon.rada.gov.ua/laws/show/1209-2018-%D0%BF#Text>

Timeframe: 2024-2030 (ongoing)

Responsible authorities/organizations: NEURC

Description: According to the Gas Market Law, the supply of natural gas to household consumers is based on a standard contract, the terms of which cannot be changed by the parties.

In order to enable suppliers to offer new products while preserving consumer protection, certain NEURC acts were amended to introduce the concept of a "basic annual offer", which each supplier supplying gas to household consumers must offer in terms of mandatory elements determined by the NEURC (validity period from May 1 to April 30 of the following year, prohibition of price increases during this period, terms and procedure for settlements, etc.) At the same time, the supplier has the right to independently determine the price of the basic annual offer, as well as to offer consumers other commercial offers within the flexibility provided by the Model Natural Gas Supply Agreement.

PM_IMG_WAM_10 Strengthening of requirements for unbundling of DSOs

Goal: to remove restrictions on competition in the retail market from abuse by natural monopolies

Legal basis: Law of Ukraine "On the Natural Gas Market", Directive 2009/73/EC

Timeframe: 2024-2026

Responsible authorities/organizations: Verkhovna Rada of Ukraine, NEURC, Ministry of Energy

Description: The requirements for unbundling of the DSOs are defined by the Gas Market Law. At the same time, these requirements should be brought into full compliance with EU best practices and Energy Community recommendations³⁴⁵. Thus, according to the EU/EU Energy Community acquis, the requirements for unbundling of the DSOs relate to legal unbundling, performance of functions and decision-making (functional unbundling), and accounting unbundling. At the same time, the unbundling of functions and decision-making consists of several mandatory elements, including unbundling at the level of governing bodies, independence and effectiveness of decision-making, separate identity, communication and branding, and confidentiality.

At the legislative level, there are no rules that would be clearly controlled by the NEURC and address most of the requirements for performing functions and making decisions (in particular, the use of common services and premises, separate communication with consumers, non-disclosure of information to related parties). For example, there is a widespread practice of using common premises, advertising, common services, and other resources by the DSOs and related suppliers, which, however, should be strictly controlled by the NEURC.

In 2025-2026, the Ministry of Energy, together with the NEURC, should work to introduce the necessary amendments to the Gas Market Law and other regulations, if necessary.

³⁴⁵ Energy Community, UNBUNDLING OF DISTRIBUTION SYSTEM OPERATORS GUIDE AND REQUIREMENTS FOR PRACTICAL IMPLEMENTATION.

v. Description of measures to ensure and develop demand side management, including tariff measures to support dynamic pricing

Electricity market

PM_IME_WEM_12 Time-differentiated prices for residential consumers

Objective: To create economic incentives for demand management of household electricity consumers.

Legal basis: Resolution of the Cabinet of Ministers of Ukraine dated June 5, 2019 No. 483 "On Approval of the Regulation on the Imposition of Special Obligations on Electricity Market Participants to Ensure Public Interest in the Functioning of the Electricity Market".

Timeframe: from 2019.

Responsible authorities/organizations: CMU.

Description: In order to encourage household consumers to implement smart meters and manage demand, in addition to the fixed electricity price, the Government has also established differentiated prices based on time zones of the day - two-zone or three-zone prices, which allow partial shifting of electricity consumption from peak periods to other periods of the day. If electricity consumption is metered by time periods, household consumers are charged a fixed price for electricity with the use of coefficients (at the consumer's choice):

- *at a two-zone price: during the hours of nighttime minimum load of the power system (from 23:00 to 7:00), a coefficient of 0.5 is applied to the base electricity price; at other hours of the day, the full fixed price is applied;*
- *at a three-zone price: during the hours of nighttime minimum load of the power system (from 23:00 to 7:00), a coefficient of 0.4 is applied to the fixed electricity price; during the semi-peak period (from 7:00 to 8:00, from 11:00 to 20:00, from 22:00 to 23:00) the full fixed price for electricity is applied; during the hours of maximum load of the power system (from 8:00 to 11:00, from 20:00 to 22:00), a coefficient of 1.5 is applied to the fixed price for electricity.*³⁴⁶

PM_IME_WEM_13 Dynamic prices for non-household consumers

Objective: To create economic incentives for demand management of electricity consumers.

Legal basis: Resolution of the NEURC dated 14.03.2018 No. 312 "On Approval of the Rules of the Retail Electricity Market".

Timeframe: since 2018.

Responsible authorities/organizations: NEURC.

Description: Since the launch of the new model of the retail electricity market on January 1, 2019, dynamic pricing for non-household consumers has been the subject of contractual relations between suppliers and consumers. Suppliers have the right to buy electricity on different segments of the wholesale market at time-of-day prices, in particular, on the DAM at hourly prices, and sell it to non-household consumers

³⁴⁶ <https://zakon.rada.gov.ua/laws/show/483-2019-%D0%BF#Text>

equipped with smart meters (Group A consumers) at dynamic prices, which makes it possible to manage demand.

According to the Rules of the Retail Electricity Market, public commercial offers of electricity suppliers must be clearly separated by their terms and the method of determining the price of electricity. In particular, suppliers' commercial offers may include prices differentiated by time of day or hourly prices, etc.³⁴⁷

Gas market

PM_IMG_WAM_11 Ensuring 100% of gas metering

Objective: to ensure the completeness of gas metering

Legal basis: Article 18 of the Gas Market Law, the Law of Ukraine "On Ensuring Commercial Metering of Natural Gas"

Timeframe: 2024-2028

Responsible authorities/organizations: NEURC, OGRM

Description: According to Article 2 of the Law of Ukraine "On Ensuring Commercial Metering of Natural Gas", all natural gas consumers must be equipped with meters by 01.01.2023. The Verkhovna Rada of Ukraine is currently considering a draft law that would extend this deadline to 01.01.2028.³⁴⁸ This draft law is expected to be adopted in 2024.

In addition, pursuant to Article 18(4) of the Gas Market Law, the Ministry of Energy, within its powers, coordinates a comprehensive analysis of the long-term economic benefits and costs of introducing new systems, including hardware, for natural gas metering, in particular those that enable consumers to actively manage their own consumption and their optimal list. Based on the results of such an analysis, the same body approves an implementation plan for the selected set of measures. As of April 2024, the relevant comprehensive analysis has not been conducted. It should be conducted in 2025-2027.

PM_IMG_WAM_12 Development of a commercial gas metering system

Objective: to ensure the reliability of gas metering

Legal basis: ESU, Law of Ukraine "On Ensuring Commercial Metering of Natural Gas"

Timeframe: 2024-2026

Responsible authorities/organizations: Verkhovna Rada of Ukraine, Cabinet of Ministers of Ukraine, Ministry of Energy, NEURC

Description: The ESU envisages the creation of a Datahub, similar to the electricity market, to solve the problems of commercial gas metering and automate the exchange of information between natural gas market participants.

³⁴⁷ <https://zakon.rada.gov.ua/laws/show/v0312874-18#Text>

³⁴⁸ <https://itd.rada.gov.ua/billInfo/Bills/CardByRn?regNum=6133&conv=9>

The creation of an information database of natural gas consumption is already provided for in Article 2-1 of the Law of Ukraine "On Ensuring Commercial Metering of Natural Gas". The Cabinet of Ministers of Ukraine should approve the regulations on this information database, which should include the main tasks, functional capabilities, natural gas market entities responsible for entering information on natural gas consumers, the terms 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 shall be determined by the Cabinet of Ministers of Ukraine. The information contained in the information database shall be protected by the information database holder in accordance with the requirements of the legislation on the protection of information in information and telecommunication systems and on the protection of personal data. The draft Regulation on the information database was published on the website of the Ministry of Energy, but has not yet been adopted.

At the same time, an important principle for the creation and operation of this information base should be its integration with information on other energy sectors. In fact, for the electricity and gas sectors, the Datahub may contain uniform data packages: for example, consumer EIC codes, identity and address, current operators and suppliers, meter readings, data on commercial metering devices, their temporary absence or replacement, etc. In addition, this solution will significantly save money on creating a new digital solution for the gas market. To fill the Datahub with information on heat, additional legislative actions will be required (e.g., assigning separate codes to heat consumers for each heat consumption facility), as well as defining a separate list of information that can be included in a single Datahub.

To create a functioning commercial metering system, it is not enough to create a Datahub. It is necessary to integrate a separate function of the commercial metering administrator into the gas market so that it is responsible for monitoring the application of the current commercial metering rules and developing the necessary changes to them, coordinating the development of a methodological framework for forecasting in the natural gas market, having the authority to resolve or provide expert opinions to resolve technical problems between gas market participants, and being a legitimate source of data for suppliers, consumers and other players. During 2025-2026, the Ministry of Energy, together with the NEURC, should work on adopting the necessary legislative changes for this purpose.

PM_IMG_WAM_13 Creating conditions for the use of contractual practice of voluntary reduction of gas consumption

Objective: to create a mechanism for managing gas demand

Legal basis: -

Timeline: 2026-2027

Responsible authorities/organizations: NEURC

Description: In order to increase the flexibility of the energy system, in particular to enable demand management by gas consumers, it is necessary to use the experience of countries such as France, which creates legislative conditions for the contractual practice of voluntary gas consumption reduction. France's experience includes not only approving the necessary amendments to the gas market regulations to enable the conclusion and execution of demand reduction contracts, but also setting a target for the percentage of consumers to be covered by this regime. According to these rules, consumers have the right to conclude an agreement with the GTSO/ DSO to voluntarily interrupt consumption. The legislation further details which consumers can exercise this right, as well as the procedure for verifying the operator's ability to quickly

reduce consumption. In this way, preparations are made to counteract the negative effects of crisis situations in the gas market.

3.4.4. Energy poverty

i. If applicable, the policies and measures to achieve the objectives set out in [paragraph 2.4.4](#)

PM_IM_WAM_06 Measures to monitor and address energy poverty

Goal: to reduce the financial burden of market energy prices for those households that need it most

Legal basis: ESU

Timeframe: 2024-2026

Responsible authorities/organizations: Ministry of Energy, NEURC, Ministry of Social Policy, Ministry of Digital Transformation

Description: The ESU defines energy poverty as a situation where the cost of energy consumed by a household consumer makes up a large part of their income, which leads to the inability to pay for the cost of energy consumed and/or reduce its consumption and, in turn, negatively affects the quality of life. At the same time, there is currently no such definition at the legislative level, as well as no quantitative and qualitative indicators that give grounds to classify people as energy poor.

The Operational Action Plan for the Implementation in 2024-2026 of the Long-Term Strategy for Thermal Modernization of Buildings until 2050 defines the following measures to overcome energy poverty to be implemented in 2024-2026:

- development of the conceptual framework of the state policy for overcoming energy poverty, definition of the term "energy poverty";
- defining the criteria for energy poverty, vulnerable categories of citizens, and people below the energy poverty line;
- Determining the number of people below the energy poverty line in accordance with the established categories;
- Setting medium- and long-term goals to reduce the number of people below the energy poverty line, including reducing the need for benefits and subsidies for housing and utility services;
- Approval of a comprehensive plan of measures to overcome energy poverty, in particular by improving the energy efficiency of buildings, taking into account the system of housing subsidies.

The ESU additionally defines the following possible measures:

- Raising awareness of households about their energy consumption and providing financial support, such as installing energy monitoring and providing a detailed report with individualized advice;
- studying the feasibility of introducing subsidies for small-scale energy renovations for vulnerable households on a first-come, first-served basis, with priority given to vulnerable consumers. In addition to financial support, personalized consultations may be provided;
- studying the feasibility of providing financial support for the installation of photovoltaic systems to provide households with electricity.

3.5. Dimension "Research, Innovation and Competitiveness"

i. Policies and measures related to the elements identified in paragraph 2.5

The implementation of programs in the areas of energy decarbonization, green energy transition, hydrogen exports, energy storage, microgrids and smart grids, and green metallurgy projects will require both large-scale retraining of existing employees in the energy sector and other related sectors and training of a new generation of specialists to design, implement and operate new projects in the energy and related sectors.

PM_RIC_WEM_01 Modernization of educational programs to cover the skills gap in the field of green transition and renewable energy

Objective: to train specialists for new projects in the energy and related sectors

Legal basis: draft Innovation Development Strategy

Timeline: 2024-2030

Responsible authorities/organizations: Ministry of Energy, Ministry of Education and Science, Ministry of Digital Transformation

Description: The post-war reconstruction of the energy sector using the 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 the higher and vocational education sector. Another urgent task is to modernize the material and technical support of scientific and educational institutions used to train energy specialists and to establish international partnerships in this area.

Among the national strategic documents that prioritize the modernization of educational programs to move the Ukrainian economy to a new level of development, one of the key ones may be the Innovation Development Strategy, which was launched by the Ministry of Digital Transformation together with the Ministry of Education and Science³⁴⁹.

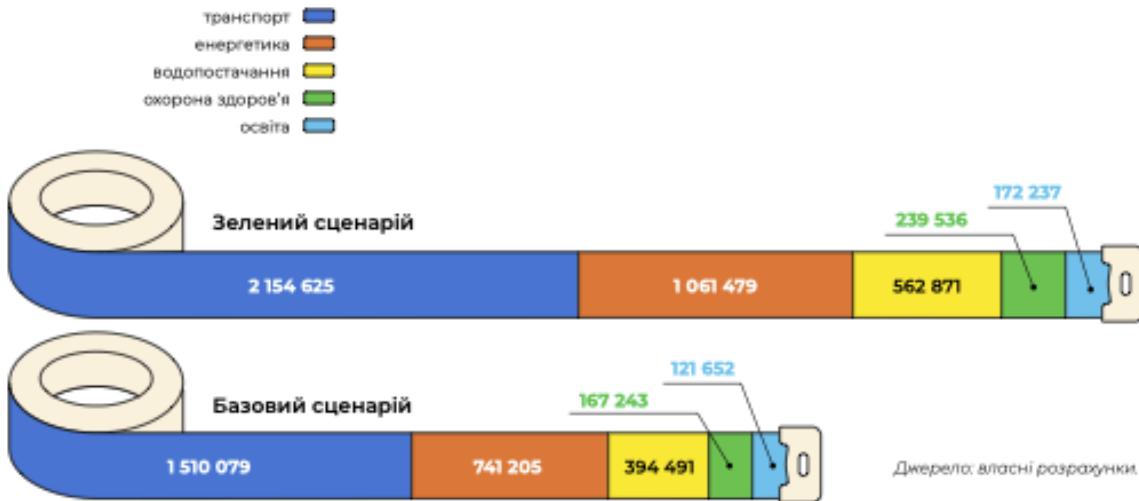
Currently, the document is at the stage of the first public discussions, but the preliminary versions of the Innovation Development Strategy posted for public discussion already pay considerable attention to closing the skills gap and training specialists for jobs of the future³⁵⁰.

According to the experts of the Resource and Analysis 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.

Estimating the need for jobs to rebuild Ukraine under baseline and green scenarios

³⁴⁹ "Presentation of the global innovation vision of WinWin took place", Pub. December 15, 2023, <https://mon.gov.ua/ua/news/vidbulasya-prezentaciya-globalnoyi-innovacijnoyi-viziyi-winwin>.

³⁵⁰ <https://winwin.gov.ua/>



Source: "Green Jobs and the Postwar Reconstruction of Ukraine"³⁵¹

One of the biggest barriers to a green recovery from the capital crunch is the shortage of skilled workers, which can only partially be covered by outsourcing. Therefore, human resource development is a priority in the research, innovation, and competitiveness sector.

PM_RIC_WAM_01 Developing corporate and international partnerships in the energy and climate sector

Goal: to improve the skills of specialists to ensure the use of new technologies

Legal basis: -

Timeframe: 2025-2030

Responsible authorities/organizations: Ministry of Energy, Ministry of Education and Science, Ministry of Digital Transformation, business entities

Description: Given the long duration of the cycle of training specialists for the energy sector through the system of higher and vocational education, it is extremely important (jointly by NPC Ukrenergo, distribution system operators, NJSC Naftogaz of Ukraine, and other energy market players of state and private ownership) to plan and implement training programs for specialists working in the energy sector to ensure their ability to implement and operate projects in such areas as:

- Decentralized generation and micro-grids
- Smart grids
- Energy storage facilities
- Electrolyzers, hydrogen synthesis, safe storage and transportation of hydrogen,
- Green ammonia, its production, storage and transportation

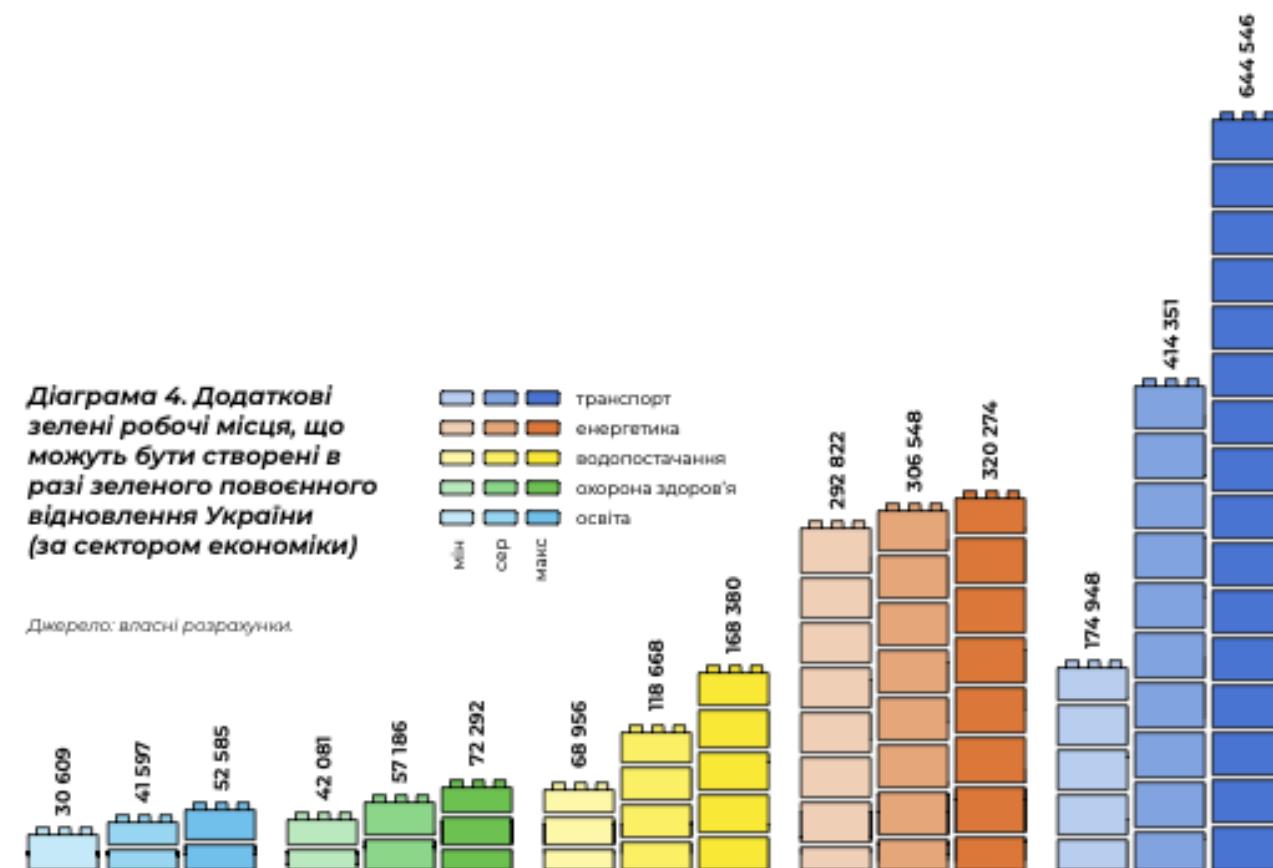
³⁵¹ Green Jobs and the Postwar Reconstruction of Ukraine. In. Andrusevych A., Andrusevych N., Kozak Z., Ptashnyk I., Romanko S. - Analytical document. - October 2023.

- Energy efficiency and energy-efficient construction.
- Cybersecurity in energy systems, and others.

Implementation of such training programs will require both public funds and funds from international donors, international financial organizations, and energy sector companies.

To accelerate the launch of specialized educational programs, it is important to involve leading international educational institutions with successful programs in the areas of distributed generation, energy decarbonization, artificial intelligence for energy, hydrogen energy, and other areas defined by the Government's strategic documents in the creation of joint educational courses and accredited educational programs. Exchange and academic mobility programs are also an effective tool for accessing advanced knowledge in the field of energy modernization.

Possible dynamics of innovative job creation under different reconstruction scenarios in the baseline and green scenarios



Source: "Green Jobs and the Postwar Reconstruction of Ukraine"

Particular attention will be needed to modernize the training of nuclear energy specialists, as the introduction of small modular reactors and reactors with power maneuvering capability will rely on a different culture of operation and management, a different technological base than the Soviet-style reactors built in Ukraine.

PM_RIC_WEM_02 Availability of grant funding for research in the field of renewable energy and climate innovation

Goal: to develop research and development cooperation

Legal basis: -

Timeframe: 2021-2030

Responsible authorities/organizations: MES, National Research Foundation of Ukraine

Description: A significant part of the technologies planned for implementation in the relevant program documents of the Government are still at the stages of scientific research or trial operation. The development of international cooperation in energy science, innovative metallurgy, and other sectors is an important area 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 innovation and scientific ecosystem, which, in particular, provides significant funding mechanisms for energy and climate science, in particular in the areas of decarbonization, green hydrogen, distributed generation, cybersecurity and other relevant areas.

The establishment of the Horizon Europe Office in Ukraine³⁵² on the basis of the National Research Foundation 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, the European Institute of Technology and Innovation, and EURATOM. With a budget of €95.5 billion for 2021-2027, Horizon Europe is a powerful source of funding for research cooperation among European innovators, and has among its key priorities (as part of Pillar II) the Climate, Energy, Mobility area. It is expected that green transformation will be among the priority areas of grant programs implemented by the National Research Foundation in cooperation with Horizon Europe.

The existing grant programs of the National Research Foundation, which provide, among other things, grants of up to EUR 50,000 / 100,000 for research projects of Ukrainian researchers, are also an important mechanism for financing research and innovation projects relevant to the decarbonization and modernization of the Ukrainian energy sector.

PM_RIC_WAM_02 Expanding research funding for renewable energy and climate innovation

Goal: to attract knowledge and technology to bridge the technology gap

Legal basis: -

Timeframe: 2025-2030

Responsible authorities/organizations: MES, National Research Foundation of Ukraine

Description: The NRFU promotes the building of scientific ties between Ukrainian and foreign research institutions, which is important for the development of modern areas of energy and climate science. However, in order to achieve a tangible effect in energy and climate research, a significant increase in funding is needed, according to expert estimates, to at least EUR 250 million per year.

In this area, it is important to develop scientific and research diplomacy with key partner countries for Ukrainian energy and green recovery. In addition to the European Union, the United States, the United

³⁵² <https://nrfu.org.ua/news/vidbulasya-urochysta-czeremoniya-vidkrytyya-ofisu-goryzont-yevropa-v-ukrayini/>

Kingdom, Japan, South Korea, Scandinavia, Switzerland, and other leading countries in the field of energy innovation and green transformation could become key partners in this area.

Cooperation with these partners in the field of energy research and innovation will allow us to attract critical knowledge and technologies to bridge the technological gap in the sector. Also, joint projects with them create the basis for further attracting funding for energy and climate research and innovation.

The ambitious plans declared by the Government of Ukraine in the development of renewable energy, hydrogen energy, localization of power equipment production, localization of production 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 need to finance research and innovation activities will amount to 750 million euros per year.

The scale of the challenges facing Ukraine in the context of developing research and innovation in the energy and climate context is not unique. All countries that are restructuring their economies to become carbon neutral face these challenges. According to the data provided by the IEA in their ETP Clean Energy Technology Guide database, there are currently more than 550 innovative technologies and components "that are present throughout the energy system and contribute to the achievement of the zero emissions goal"³⁵³.

PM_RIC_WEM_03 Developing corporate investment in climate technology and renewable energy solutions

Goal: to create favorable conditions for investment

Legal basis: -

Timeline: 2024-2030

Responsible authorities/organizations: Ministry of Economy, Ministry of Energy, Ministry of Environment, other stakeholders

Description:

Improving the energy efficiency of industry

Reducing industrial energy consumption per unit of GDP in Ukraine is an important reserve for decarbonization, energy security, and enabling energy exports as one of the growth areas of the Ukrainian economy.

The outdated production base, lack of adequate energy management mechanisms, and high cost of capital for capital investments reduce the competitiveness of Ukrainian enterprises in international markets, especially in view of the introduction of CBAM (Carbon Border Adjustment Mechanism).

This challenge can be addressed by stimulating businesses that implement energy-efficient solutions and modern standards for the construction of industrial complexes (e.g., BREAM) through financial instruments (compensation of interest on loans, targeted subsidies), tax mechanisms (tax benefits for the import or production of energy-efficient equipment and technologies), and the introduction of new building standards in line with European energy-efficient construction regulations with appropriate support mechanisms into the regulatory framework.

³⁵³ ETP Clean Energy Technology Guide <https://www.iea.org/data-and-statistics/data-tools/etp-clean-energy-technology-guide>

Another important task for competitiveness through efficiency is training programs for business owners and managers, modernization of relevant curricula in higher and vocational education, and relevant communication and awareness-raising activities.

One of the drivers of energy efficiency is also the desire of business owners to ensure energy security and business continuity by developing their own generation against the backdrop of Russian attacks on the Ukrainian power grid.

Green chemistry

Green chemistry is an important component for the implementation of decarbonization and green transition projects, as the development of research and development in this area is necessary for waste and biomass processing, for the production of biomethane and green ammonia, green products of basic chemical synthesis (synthesis gas, methanol, propylene, butylene, etc. to replace fossil fuels).

Research in green chemistry is also needed for low-carbon modernization of the oil industry, carbon dioxide extraction, storage, and conversion (in particular, into biomethane), and the development of new solutions in hydrogen technology and energy efficiency.

Green transformation and climate adaptation of the agricultural sector

The full-scale invasion of Ukraine by the Russian Federation has not only destroyed Ukraine's two largest metallurgical enterprises (Azovstal and MMK), but has also caused extreme damage to Ukraine's first major export sector, the agricultural industry. The blocking of sea export routes, systematic attacks on grain storage and processing facilities, the occupation and destruction of a large part of agricultural processing, the seizure and mining of arable land, the destruction of irrigation systems by blowing up the Kakhovka hydroelectric dam, and the environmental crimes of the Russian occupiers have led, in addition to huge human losses, to the loss of jobs, foreign exchange earnings in Ukraine, the reduction of sales markets, and general pessimism among agricultural business owners.

In addition, agricultural enterprises in southern Ukraine are suffering from climate change and are increasingly dependent on artificial irrigation, suffering from abnormal climatic events and the emergence of invasive species, which reduces the productivity of agricultural enterprises, increases their capital costs and limits the ability to attract capital to the sector.

On the other hand, the development of bioenergy, biomethane and bioethanol production, active implementation of agro-voltaics and precision farming and spot irrigation technologies can provide Ukrainian farmers with new export opportunities, ensure their energy self-sufficiency by switching vehicles and land cultivation equipment to domestically produced biofuels, reduce greenhouse gas emissions from land use and the dependence of agricultural production on artificial irrigation.

Given the capital intensity of implementing climate-friendly agricultural innovations, an important area, in addition to research and development, is to ensure the availability of financing through interest compensation programs, tax incentives, and grant programs funded by government partners and international financial organizations.

Technologies for carbon dioxide extraction and storage

Given the current structure of generation and industry in Ukraine, long cycles of green economic transformation, the rapid introduction of carbon dioxide capture, storage and processing systems is an important factor in decarbonizing the economy. The existing research and technological base of CO₂ capture and storage technologies in Ukraine is at an embryonic level, so stimulating research in this area and implementing relevant technologies is an important element of reducing emissions in the short term.

Artificial intelligence technologies for the energy sector

The growing share of renewable sources in the Ukrainian energy mix, the development of decentralized generation, the need to implement demand-side response solutions, the proliferation of energy storage facilities, microgrids³⁵⁴ and smart grids will require speed of decision-making that will often be unavailable to dispatchers of the IPS of Ukraine. Artificial intelligence should come to the aid of human intelligence in this area, ensuring both frequency stability and prompt response to dynamic changes in the power 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 innovations in this area and implementing them responsibly will help increase the flexibility of the power system and create new, dynamic mechanisms for responding to challenges. In the future, the development of artificial intelligence systems for the energy sector, 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

In Ukraine, the ability to innovate was demonstrated primarily by those sectors that were less dependent on the legacy of past investments and complex government 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 services sector in Europe.

A sufficiently high-quality education system and the absence of state regulation (and the virtual absence of a domestic market) contributed to the start and rapid growth of the IT services industry, the third largest sector of Ukrainian exports.

The absence of heavy and expensive reconnaissance drones made it possible to build an aerial reconnaissance system based on affordable drones for domestic use, and then launched domestic production of reconnaissance and combat drones.

Ukraine's near absence of a navy has created a sector of maritime attack drones, which has led a significant part of the Russian Black Sea Fleet to relocate to Novorossiysk and Ochamchira.

The absence of a paper check tradition and the electronic bank clearing system created in the 1990s made banking transactions extremely fast and cheap and launched Ukraine's digital banks.

The transition to mobile identity technologies (including digital banks) has made it possible to launch digital passports, driver's licenses, and many electronic services in the Ministry of Digital Transformation's Diia ecosystem.

Innovation leapfrogging is possible in sectors where the innovation system jumps through several stages of development, overcoming regulatory constraints and taking advantage of the availability of the latest solutions that have gone from exclusive to mass.

The Ukrainian energy sector also has such an opportunity, as many technologies in the areas of smart grids, microgrids, energy storage, renewable energy, metering and consumption data transmission systems have improved significantly over the past decade, while falling in price dramatically. And where the price drop is insufficient, mass production of certain solutions can trigger economies of scale and reduce the cost of these innovations.

³⁵⁴ 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>.

PM_RIC_WAM_05 Development of exports of climate and renewable energy technologies

Goal: to develop competitive production of power equipment

Legal basis: NES, ESU

Timeframe: 2025-2030

Responsible authorities/organizations: Ministry of Economy, Ministry of Energy, other stakeholders

Description: The Government of Ukraine's program documents envisage a transition to domestic production of energy technologies and equipment, from transformers to wind farm components and floating wind farm platforms. This ambitious task requires substantial capital attraction and effective public-private partnerships. Given the state of many enterprises in the energy sector, the obsolescence of many technological developments and the production base, the effective development of competitive production of energy equipment is possible only if:

- Development of enterprises focused on both domestic and export markets
- Utilizing a technology and standards base that is compatible with EU regulations and other potential markets
- War risk insurance and the introduction of special security standards for such enterprises (in particular, inclusion in the list of critical infrastructure facilities and the creation of areas of enhanced protection by air defense systems)
- Attracting leading international concerns to organize such production in Ukraine
- Introduction of modern corporate governance standards for state-owned enterprises, their rehabilitation and restoration of profitability
- Privatization of state-owned enterprises that have lost their feasibility due to production stoppages and technological backlogs.

Since the Government's policy documents also suggest that such equipment should be designed in Ukraine, it is necessary to provide training programs for relevant specialists and modernize educational programs for power equipment engineers, attract foreign specialists and license technologies from leading international manufacturers for production in Ukraine.

The speed of launching and scaling up such production facilities will be a priority for the recovery of Ukraine's energy sector, which in some cases will require unpopular decisions: creating new modern flexible facilities instead of trying to revitalize the giants of the past.

PM_RIC_WEM_04 Competitiveness of the Ukrainian economy against the background of implementation of EU legislation in the field of energy labeling and ecodesign

Objective: to mitigate the negative effects of changes in the regulatory framework

Legal basis: ESU

Timeframe: 2025-2030

Responsible authorities/organizations: Ministry of Economy, Ministry of Energy, State Agency on Energy Efficiency and Energy Saving, other stakeholders

Description: Adoption and harmonization of technical regulations in the energy sector with EU legislation, adaptation of Ukrainian legislation on energy labeling and ecodesign to EU legislation, development and approval of national standards and guidelines for the application of technical regulations opens up new opportunities for the Ukrainian economy, but also creates significant challenges for Ukrainian producers.

Changes to key standards and regulations governing the production of equipment, technologies and materials for the energy, construction, metals, agricultural and other sectors will require Ukrainian companies to invest heavily in employee training, adjusting production and business processes, implementing new production standards and obtaining certifications. In some cases, this may require substantial modernization of production facilities and prolonged production shutdowns.

Preserving the competitiveness of Ukrainian enterprises and mitigating the economic stress caused by changes in the regulatory framework requires active information of economic entities about the change process, widespread deployment of training and certification programs and their financial support (in particular, from the state budget and international donors), financial and tax incentives for modernization of production facilities of companies operating in this market.

It is also important to have a clear plan for the transition period between the existing and new regulations and an easy procedure for confirming such a transition.

An effective change in the system of regulatory standards can create new export sectors of the Ukrainian economy and compensate for the loss of traditional markets with post-Soviet standards.

PM_RIC_WAM_04 Active attraction of venture capital investments in climate innovation and renewable energy companies

Goal: to create favorable conditions for investment

Legal basis: -

Timeframe: 2025-2030

Responsible authorities/organizations: Ministry of Economy, Ministry of Energy, Ministry of Environment, other stakeholders

Description: Ukraine's venture capital sector has matured and supported many disruptive companies in various sectors, but its key focus remains on software and IT innovation. Compared to IT, energy solutions are much more capital-intensive, have longer return on investment cycles, and are riskier due to the high level of regulation in the sector.

To date, most companies that have successfully attracted venture capital investment in the energy and climate innovation sector operate primarily in export-oriented markets. Ukrainian venture capital funds that have investments in green startups in their portfolio include Startup Network, SMRK Venture Fund, Angel One Fund, and Vesna Capital. The amount of capital and the amount of deals in the IT-centric startup market in Ukraine is much higher by an order of magnitude.

However, this trend is not unique, as the key players in the energy and climate sector in the global venture capital markets are not so much traditional venture capital funds as corporate funds and accelerators. For example, among the companies that have invested the most in green startups are such giants as Shell Technology Ventures and BP Ventures, and the Bright Technology Coalition/Bright Technology Ventures, created by Bill Gates, is actively investing in the sector, Khosla Ventures of IT entrepreneur Vinod Khosla is active in the sector, and there are many narrowly 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.

As for acceleration services for green startups, the global trend in this area is either to form corporate accelerators (such as e.On agile by the German energy giant e.On or TechX Clean Energy Accelerator, created jointly by the municipality of the Scottish city of Aberdeen and oil and gas companies in the North Sea), or in partnerships between leading accelerator networks and corporate partners (for example, the creation of TechStars Energy in cooperation with the Norwegian corporation Equinor or the RockStart Energy Program in cooperation with Shell, Orsted, Alliander and CEZ Group).

Given the world's leading experience, the development of venture capital financing for the energy sector is possible on the basis of existing mechanisms, such as the creation of specialized grant programs of the Ukrainian Startup Fund, which operates at the pre-seed stage, as well as stimulating the creation of corporate programs for the development of innovations in the energy sector and the launch of corporate accelerators by Ukrainian businesses, and the active involvement of international venture capital funds and accelerators focusing on climate and energy.

PM_RIC_WAM_06 Promoting SME competitiveness through green transformation and access to new markets

Goal: Increase the competitiveness of small and medium-sized businesses (SMEs) and their ability to integrate into climate-friendly supply chains

Legal basis: National Economic Strategy for the period up to 2030, Strategy for the Development of Industrial Parks for 2023-2030³⁵⁵, draft Strategy for the Recovery, Sustainable Development and Digital Transformation of Small and Medium Enterprises for the period up to 2027³⁵⁶

Timeline: 2025-2030

Responsible authorities/organizations: Ministry of Economy, Ministry of Finance, other stakeholders

Small and medium-sized enterprises are among the most dynamic players in the Ukrainian economy in terms of creating new jobs and developing new products and services. However, SMEs are also quite vulnerable to military and post-war challenges, and therefore require measures to support competitiveness and economic stimulation.

Given the challenges facing the Ukrainian economy in the context of the full-scale invasion of Ukraine by the Russian Federation, important priorities for the preservation and development of small and medium-sized businesses may coincide with steps aimed at green business transformation, in particular:

- Promoting business energy security through renewable energy sources and energy innovations, including energy storage systems, smart grids, and microgrids;
- Encourage access to export markets that set high climate and environmental standards for entry (e.g., CBAM) and integration into relevant supply chains through training, certification, and promotion initiatives;
- Stimulating the reduction of energy consumption and emissions, in particular through ESCO mechanisms;
- Supporting technological modernization of production facilities and raising environmental standards of production facilities through access to green financing, commercial loan interest reimbursement programs and grant programs

³⁵⁵ <https://zakon.rada.gov.ua/laws/show/176-2023-%D1%80#Text>

³⁵⁶ <https://www.me.gov.ua/Documents/Download?id=271105ad-b22c-4adf-9076-7c1b48453df9>

- Promoting the implementation of energy, emissions and climate technology regulations under the EU regulatory framework and developing relevant capacities in the SME sector;
- Improving resource efficiency and implementing circular economy principles;
- Development of industrial symbiosis models based on industrial parks and cluster mechanisms;
- Development of a joint production and technological infrastructure for the sharing of technological resources by small and medium-sized businesses.

Among the tools and measures that can support the development of small and medium-sized businesses, in parallel with the decarbonization of the economy, in particular, the reduction of greenhouse gas emissions per unit of GDP:

- Developing financial products aimed at supporting the "green transition" of small and medium-sized businesses and the introduction of energy and resource-efficient production technologies. In addition to green loan products, leasing products, refinancing of existing loans, and focused grant programs for SMEs can also be effective in this area. An important factor is to simplify the procedures for such financial programs as much as possible, to digitalize all processes, and to shorten the decision-making time as much as possible.
- Development of business infrastructure for SMEs in the form of eco-industrial parks³⁵⁷, which will allow small and medium-sized businesses to access technologies, best practices and financing, and reduce environmental damage from their activities³⁵⁸. The creation of eco-industrial parks is in line with the Strategy for the Development of Industrial Parks for 2023-2030, and a favorable regulatory framework in the energy sector can help industrial parks provide resident businesses with electricity through their own generation, including from renewable sources³⁵⁹.
- Developing national and regional circular economy strategies that will help build sustainable processing chains in various sectors of the economy and reduce environmental damage from production waste and long logistics distances.

The combination of such tools and measures will help both reduce greenhouse gas emissions and waste accumulation and increase the depth of processing of raw materials into final products, as envisaged by the NES.

ii. If applicable, cooperation with other Member States in this area, including, where relevant, information on how the objectives and policies of the ETS Plan are adapted to the 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.

³⁵⁷ Eco-Industrial Parks: Creating Shared Prosperity And Safeguarding The Environment, UNIDO, 2016 https://downloads.unido.org/ot/42/49/4249024/UNIDO_EIP-brochure_high-res_15June.pdf

³⁵⁸ Regional policies and eco-industrial development: The voluntary environmental certification scheme of the eco-industrial parks in Tuscany (Italy), Journal of Cleaner Production - April 2015 <https://www.researchgate.net/publication/275634947>

³⁵⁹ Industrial Parks in Ukraine: State Regulation and Development, The Page, May 3, 2023, <https://thepage.ua/ua/experts/industrialni-parki-mozhut-stati-osnovoyu-dlya-pislyavoyennoyi-vidbudovi>

iii. If applicable, funding measures in this area at the national level, including Union support and use of Union funds

Today, several grant programs are being implemented in Ukraine at the expense of international donors and international financial organizations to support businesses that create and implement climate and energy innovations. These programs include the EU-funded EBRD Climate Innovation Vouchers project, the USAID Competitive Economy of Ukraine program, the European Innovation Council's Seeds of Bravery project, and others.

These programs and projects provide significant assistance to Ukrainian SMEs, 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 efforts to administer such grants.

Increasing the amount of grant support in this area is possible by expanding the possible pool of donors, attracting co-financing from the state budget, and reducing business costs through mechanisms for subsidizing the lease of state property, creating and accessing technology and equipment parks, equipment leasing, and other tools to support grantees of such programs.

Another important tool for the development of energy sector enterprises that contribute to decarbonization and green transition may be financial innovations in green banking and the development of appropriate financial products (loans, leases, exports) with the involvement of funding from international financial institutions to increase the availability of financing and reduce the cost of capital.

In particular, see above (section 3.5.i), PM_RIC_WEM_02 Availability of grant funding for research in renewable energy and climate innovation, PM_RIC_WAM_02 Expanding funding for research in renewable energy and climate innovation, PM_RIC_WEM_03 Developing corporate investment in the purchase of climate technologies and renewable energy solutions.

SECTION B. ANALYTICAL FRAMEWORK

4. CURRENT SITUATION AND FORECASTS, TAKING INTO ACCOUNT EXISTING POLICIES AND MEASURES

4.1 Forecast of the dynamics of the main exogenous factors affecting the development of the energy system and GHG emissions

The full-scale invasion of Ukraine by the Russian Federation has caused significant damage to the country's economy, leading to population migration, destruction of production infrastructure, a corresponding drop in business activity, and obviously causing high uncertainty about the path of post-war recovery. The current state of the economy remains largely unknown, as most statistical data is unavailable. Generally speaking, energy demand is determined by macroeconomic factors such as gross domestic product (GDP), industry output or value added, population, and others.

Meanwhile, due to a lack of current information and a high level of uncertainty, the future dynamics of the energy demand factors discussed below cannot always be properly assessed using traditional approaches, but must rely mainly on assumptions and indirect information from open sources.

i. Macroeconomic forecasts (GDP and population growth)

Since 2014, Ukraine's economy has been functioning in the context of the Russian Federation's hybrid war against Ukraine. However, the unprovoked full-scale invasion of Ukraine by the Russian Federation, which began in 2022, has become a new test of the strength and resilience of Ukrainian society and economy. In addition to the deaths and destruction that Ukraine has suffered, the economy has had to adapt to:

- large-scale migration of the population and a decline in purchasing power;
- a significant narrowing of logistics routes, a narrowing of economic activity of enterprises, including export-oriented ones;
- significant electricity shortages in certain periods and blackout schedules introduced in October 2022 and early 2023;
- increased defense spending, which led to a widening of the state budget deficit to UAH 914.9 billion in 2022;
- incurred huge losses as a result of Russian aggression, estimated at trillions of hryvnias.

However, the success of Ukraine's defense forces, the coordinated work of the government and business, the indomitable spirit of the population, the speed of restoration of destroyed and damaged critical infrastructure, and systematic financial support from international partners helped maintain economic stability. As a result:

- GDP decline was significantly less than expected, amounting to 29.1% (at the beginning of the full-scale invasion of Ukraine by the Russian Federation, estimates ranged from 40-50%);
- Consumer price growth was also lower than expected at the beginning of the full-scale invasion of Ukraine by the Russian Federation and roughly comparable to price changes in a number of European countries, amounting to 26.6% (year-on-year);

- Businesses quickly adapted to the difficult conditions and returned to work after almost 86.1% of enterprises suspended their operations in February-March 2022.

Thus, despite all the difficulties and challenges, the economy managed to maintain relative macroeconomic and price stability in the context of hostilities, overcome a large-scale production shutdown and the consequences of the outflow of labor resources caused by people moving to safe places.

The macroeconomic forecast of the NEC is based on the Forecast of Economic and Social Development of Ukraine for 2024-2026 and the assumptions of the macroeconomic scenarios of the Plan of Ukraine until 2033, which were extrapolated to 2050 by experts of the Institute of 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 sector, %.

	2022	2023-2025	2026-2030	2031-2040	2041-2050
Agriculture, forestry and fisheries	-25,2	0,9	5,3	1,4	0,5
Extractive industry	-33,2	7,5	1,8	0,8	0,1
Processing industry	-42,2	5,7	6,7	6,1	4,1
Supply of electricity, gas and steam	-32,5	5,8	4,9	1,9	1,3
Construction	-66,9	17,8	15,0	12,5	3,1
Wholesale and retail trade; repair motor vehicles and motorcycles	-32,2	5,8	5,4	4,6	2,6
Transportation, warehousing, postal and courier services	-40,5	2,1	5,7	4,5	2,5
Other types of economic activity	-14,3	4,9	4,6	4,2	2,8
GDP	-28,8	5,0	5,4	4,6	2,8

Macroeconomic scenarios define the future structure of the economy, the corresponding volumes of energy use and GHG emissions, and set the conditions for demographic development.

At the beginning of 2022, the population of Ukraine amounted to 41.2 million people (excluding the so-called territories of the Autonomous Republic of Crimea and Sevastopol) or about 37.3 million people (excluding the so-called territories of the Autonomous Republic of Crimea, Donetsk and Luhansk regions) with a tendency to a constant 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 macroeconomic forecasts described above. For this purpose, special assumptions were developed for 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 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
Share of urban population, %.	69,7	67,9	71,4	70,7	70,0	69,4	68,8

ii. Sectoral changes expected to affect the energy system and GHG emissions

The reconstruction of destroyed infrastructure (transport, energy), housing and social infrastructure, as well as the development of the defense industry will become Ukraine's main security priorities in the medium term. Accordingly, investments will be directed to both construction and equipment (defense, energy, etc.), which will stimulate the development of construction, production of domestic engineering products, and the purchase of imports for investment purposes.

On the demand side, the growth will be driven by investment demand as a result of the implementation of production and infrastructure development projects and the gradual reconstruction of the affected areas. Although this component will continue to be the fastest growing among the other demand components, it will not be enough to restore most of the damaged production facilities and infrastructure and modernize production in the coming years.

As for the dynamics of the main components of GDP on the supply side in the short term, the following is expected.

The positive dynamics of the service sector, which is sensitive to the activity of the population and, given its mobility and high level of IT use, is more autonomous, as well as quite maneuverable and flexible to consumer needs, opening up not only domestic markets. Its further development will be aimed at expanding the range of services provided through digital platforms (including to the EU markets) by improving existing or introducing new marketing strategies, seeking opportunities to diversify the market offer, and creating new virtual products and services.

At the same time, industrial production will be restored. In the short term, the key task will be to develop effective means, methods, and technologies in the field of security and defense planning to meet the priority needs of the Ukrainian army, which will stimulate further development of machine building. The extractive industry will also recover relatively quickly and steadily, given the achievement of maximum production autonomy in the future to create a solid foundation for recovery during the postwar period, which will gradually make up for the potential that has been reduced over a long period of decline.

The food and chemical industries and textile production will be actively recovering, as their activities are related to meeting priority needs and they are mostly small and medium-sized enterprises that are more mobile and have greater ability to maneuver logistics and sales of their products. The most difficult situation will be for large industrial enterprises, in particular metallurgical ones, some of which have been destroyed. It is not easy for such enterprises to reconfigure their logistics and relocate their production facilities, and it will take a longer period to restore them or create completely new modern production facilities.

The development of the domestic agricultural sector in the forecast period will take place in the context of ensuring food security and maintaining the country's position in global agricultural rankings as a leading exporter of agricultural products.

The need to quickly restore infrastructure (roads, bridges, communications), industrial, social and residential facilities that were heavily damaged or destroyed during the hostilities will require active investment in the construction sector, while defense spending remains high, which will contribute to its further development.

The gradual intensification of economic processes will also support the transportation sector, which in most sub-sectors was both suspended during martial law and significantly affected by enemy attacks. The development of the transport sector will be facilitated by prioritizing the restoration of transport infrastructure and the development of new alternative transportation routes as key logistics channels for the supply of products to international markets.

Growth in private consumption and production activities, as well as the establishment of logistics links, will stimulate trade.

Thus, taking into account all factors on the demand side and production capacities, the GDP growth rate of 5.3% in 2023 may be maintained until 2030, with a gradual slowdown to 3%-4.5% in the longer term.

iii. Global energy trends, international fossil fuel prices, carbon prices under the EU ETS

Assumptions about global fuel prices

The forecast of import prices for the main types of energy resources for Ukraine is based on the price forecast of the International Energy Agency (World Energy Outlook 2023, Announced Pledges Scenario)³⁶⁰ (Table 4.3). As can be seen from the table below, prices for all carbon-intensive energy resources will decline, albeit at a slower pace than in the crisis year of 2022.

Table 4.3. Forecast of world energy prices

	Unit	2010	2022	2030	2050
Coal	USD/t USD/t	122	290	68	53
Crude oil	USD/bbl USD/ barrel	103	98	74	60
Natural gas	USD/ mbtu USD/million boe	9,9	32,3	6,5	5,4

Carbon price assumptions

Assumptions about the price of greenhouse gas (GHG) emissions differ depending on the scenario. For example, in the draft NECP (published by the Ministry of Economy on February 14, 2024), under the "with existing policies and measures" (WEM) scenario, the CO₂ tax rate₂ remains at UAH 30 per ton during the martial law regime and potentially for some time afterwards (until 2025 inclusive). It is expected that all taxes, including the CO₂ tax, will be indexed starting in 2026₂. Accordingly, the rate of the CO₂ tax₂ will increase slightly and will be around €1/t by 2050. Under the "with additional policies and measures" (WAM) scenario, the same assumptions are made about the CO₂ tax rate₂ until 2025 (30 UAH/t during martial law, and about 1 EUR/t from 2026). However, it is assumed that in the longer term, the CO₂ tax reform₂ (currently under development) will be implemented, which will include revision of the tax rate and tax base. As a result, it is expected that the tax will be extended³⁶¹ to the transportation, agriculture, residential and commercial sectors.

³⁶⁰ World Energy Outlook 2023 // International Energy Agency. Available from: <https://www.iea.org/reports/world-energy-outlook-2023>

³⁶¹ As of 2024, the CO₂ tax applies to GHG emissions from stationary sources, i.e., in fact, to the energy, industry, and energy supply sectors, which are separately represented in the TIMES model.

In addition, the ETS is also expected to be introduced in a test mode starting in 2026. However, it is expected that the framework conditions for the ETS in Ukraine will gradually approach the EU ETS. The introduction of the CBAM mechanism by the EU will further stimulate Ukraine to accelerate the process of introducing the national ETS and harmonize it with the EU ETS. Therefore, it is assumed that the price of CO₂ emissions (the total impact of the CO tax₂ and the ETS) on the domestic market will increase steadily until 2050. However, given that as of 2024, a full-scale war has been going on for three years, a significant part of the industrial sector has been destroyed, and the poverty rate has increased significantly, a rapid increase in carbon prices to the level of the EU ETS in 2030 is unrealistic, as the Ukrainian economy and population will need time to recover from the war and adapt to the significant increase in energy and carbon prices. Therefore, it is assumed that the trajectory of growth of the price of CO₂ emissions in Ukraine will lag behind the price on the European carbon market, which is currently about 65 euros/t CO₂, while a year ago it was about 100 euros/t CO₂³⁶².

At the same time, the International Energy Agency's (IEA) "announced commitment" scenario³⁶³ for developing countries (including Ukraine) with net-zero emissions commitments looks more realistic for Ukraine, but is also quite ambitious. According to this scenario, the price of CO₂ emissions is expected to increase to USD 40 (or EUR 38) per tpy. USD (or 38 EUR) per t of CO₂ by 2030 and up to 160 USD (152 EUR) per t of CO USD (152 EUR) per t of CO₂ by 2050.

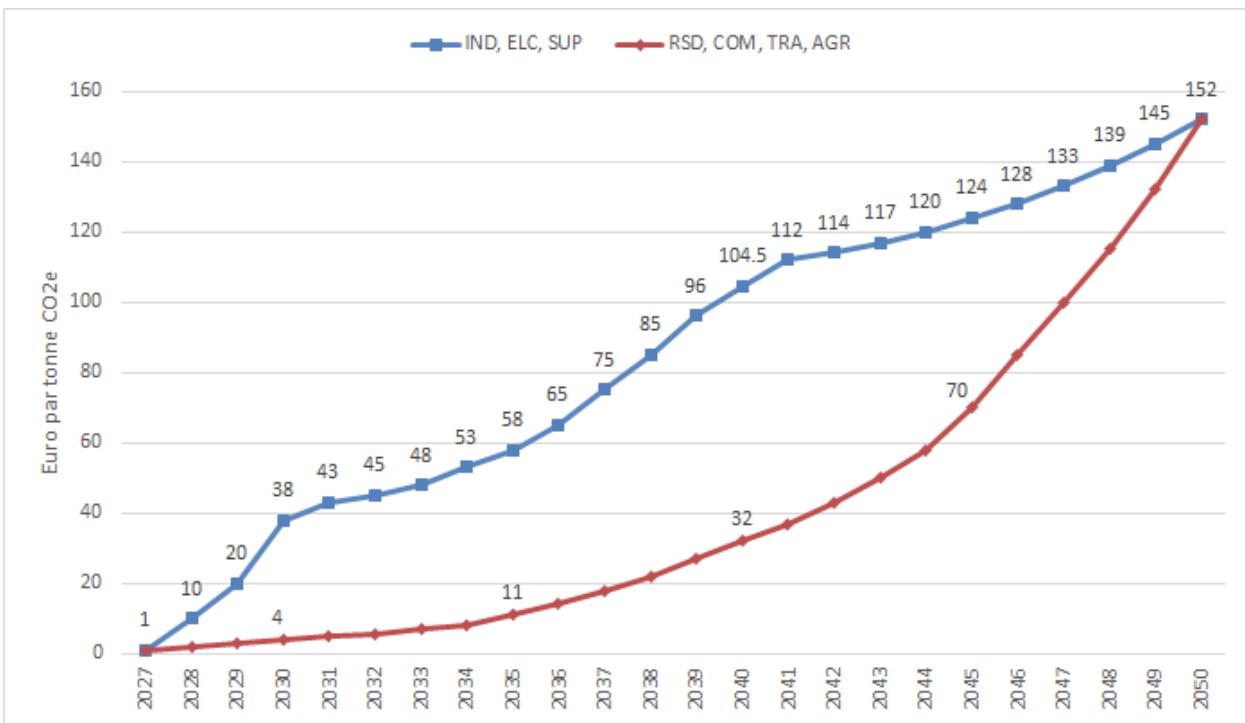
Thus, to model the scenario "with additional policies and measures" (WAM) within the NECP, in particular, for the energy, industry and energy supply sectors, the following assumptions are used that the price of CO emissions₂ until 2025 (30 UAH/t during martial law, and from 2026 to 2027 about 1 EUR/t), while in the future it will reach the levels of the above IEA scenario, i.e. in 2030 - 38 EUR/t, in 2040 - 104.5 EUR/t, and in 2050 - 152 euros/t of CO₂. At the same time, other sectors (transportation, agriculture, residential and commercial sectors) are expected to see a slower price increase (see Figure below).

At the same time, after the martial law is lifted, the NECP is planned to be updated, including a revision of the assumptions on the price of CO emissions₂. After the launch of the national ETS and the adoption of the roadmap for reforming the carbon tax, which is expected within the next two years, it will be possible to formulate a clearer vision of the national carbon market development and a forecast of the CO price₂.

Figure 4.1: Carbon price assumptions for different sectors by 2050

³⁶² <https://tradingeconomics.com/commodity/carbon>

³⁶³ See Table B.2 Announced Pledges Scenario for Emerging market and developing economies with net zero emissions pledges, <https://iea.blob.core.windows.net/assets/86ede39e-4436-42d7-ba2a-edf61467e070/WorldEnergyOutlook2023.pdf>.



iv. Changes in the cost of technology

The table below summarizes the key technical and economic characteristics of selected electricity and heat generation technologies that were used as assumptions in the modeling process underlying this NERP. Capital costs include the cost of capital, but the model also takes into account operating costs.

Table 4.4. Short list of promising technologies for electricity and heat production

Technologies	Capital expenditures (CAPEX), €/kW _e							Efficiency (electrical), %	GROSS MARGIN, %	Lifetime, years	Coefficient of production				
	2020	2025	2030	2035	2040	2045	2050								
Thermal power plants (TPPs) and combined heat and power plants (CHPs)															
NPP															
New large power units	4400							33	88	60	0.03				
Extending the life of existing power units	254							33	80	30	0.04				
New small modular reactors (160 MW)	4400							33	90	80	0.04				
Nuclear high-temperature 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				
Quick 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 heat and power plant	800							50	50	35	0.84				
Open-cycle CHP plant	920							45	50	35	0.95				
Extension of the service life of existing CHP plants	280-650							19-43	50	15	1.1-3.0				

Combined cycle CHP + Carbon capture	2250								45	50	35	0.84					
Bioenergy																	
TPPs on wood biomass	2800	2750	2700	2650	2600	2550	2500	24	50	30	-						
Combustion waste power plants (CWPPs)	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 plants + Carbon capture	3650								24	50	30	-					
Biogas power plant + Carbon capture	5350								42	50	30	-					
Energy plant power plants + Carbon capture	3750								24	50	30	-					
CHP on wood biomass	3400	2850	2800	2750	2700	2650	2600	20	50	35	2.0						
CHP on biomass from waste	3400	2950	2850	2850	2900	2750	2700	19	50	35	1.9						
CHP on energy plants	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 with energy crops + Carbon capture	4450								20	50	35	1.5					
Wind power plants (WPPs)																	
Land-based 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 a 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	-						
Rooftop solar power plants	900	875	850	800	750	700	600	-	13.5	25	-						
Geothermal power plants (GePP)																	
Geothermal power plant	4300-3600								-	35-55	25	-					
Hydroelectric power plants (HPPs)																	
Small hydropower plants	3250-3080								-	30	40	-					
Large hydroelectric power plants	3300-3100								-	33-36	60						
HPSP	610								-	26	60	-					
Energy storage facilities (ESF), 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	-						
Tank storage of hydrogen, large volumes	4600	3600	3400	3200	3000	2800	2500	100	100	22	-						
Tank storage of hydrogen, small volumes	2650	2075	1900	1800	1700	1600	1500	100	100	22	-						
Fuel cells (Hydrogen)																	
TPPs and CHPs with fuel cells	2530	1125	1125	844					50	60	10	0.64					
Heat and power plants (Boiler houses)																	
Gas boiler house (with the possibility of bio- or synthetic methane)	300								92	50	40	-					
Boiler house on wood biomass	145	142	140	138	136				85	50	35	-					

Boiler house on biomass from industrial waste	350	320	300	280	270	260	250	80	50	35	-	
Boiler house on aerothermal energy				1100				250	50	25	-	
Hydrogen boiler house				390				64	50	35	-	
Other important technologies												
Direct air carbon capture (DAC)	2.32	2.05	1.86	1.8	1.7	1.6	1.5	0.014-0.007 PJ/kWh of CO ₂	90	25	-	
Methanation	600	500	450	400	350	300	250	75-83 (H ₂)	95	25	-	
Production of direct reduced iron (DRI) from hydrogen	360	355	350	345	340	333	324	17 PJ H /mt ₂	85	40	-	
Low-carbon production of iron ore concentrate				96				64-75	1	30	-	
Alkaloid electrolyzer	650	500	450	375	300	275	250	67-75	97	25-35	-	
Electrolyzer with proton exchange membrane (PEM)	925	800	650	550	450	425	400	58-71	97	20-30	-	
Solid oxide cell (SOEC) electrolyzer	4500	3200	1900	1620	1340	1060	780	77.5-83.5	91	10-20	-	
High capacity steam reforming of methane				10.6				77	90	20	-	
Low power steam reforming of methane				22				69	80	20	-	
Solar steam reforming of methane, high capacity				9.8				120	90	20	-	
Solar steam reforming of methane, low power				27				60	90	20	-	
High capacity gasification of biomass into hydrogen			63.4		47.6			50	90	20	-	
Low-capacity gasification of biomass into hydrogen			111		95			33	71	20	-	
Steam reforming of ethanol				234				67	90	20	-	

4.2 Decarbonization dimension

4.2.1. GHG emissions and removals

i. Trends in current GHG emissions and removals under the EU ETS, joint efforts, LULUCF and different energy sectors

According to the GHG Emissions Inventory for 1990-2021, in 2021, total GHG emissions in Ukraine amounted to 341.5 million tons of CO₂-eq (including LULUCF). This is 62.5% less than in 1990, but 7.5% more than in 2020.

As a result of the post-Soviet economic downturn, Ukraine's GHG emissions decreased from 911.4 million tons of CO₂eq (including LULUCF) in 1990 to 405 million tons of CO₂eq in 2000. Although the economy started to recover after 2000 and annual GDP growth rates were strong, GHG emissions continued to decline (see Table 4.5). This is due to the fact that Ukraine's economy has been undergoing significant structural changes, and inefficient energy-intensive sectors have been partially replaced by trade, services, and the financial sector. In addition, the modernization of production had a significant impact on GHG emission trends, which reduced the energy intensity of major industrial goods.

The trend in GHG emissions in 2008-2021 was determined by the impact of the global financial and economic crisis of 2008-2009 and the temporary occupation of part of Ukraine's territory by the Russian Federation in 2014, which largely determined commodity production in the main export-oriented industries (metallurgy, chemical industry, mechanical engineering, etc.), which in turn affect the supply sectors - electricity, mining (ore and coal mining). The economic recovery after strict COVID-19 measures in 2020 led to an increase in greenhouse gas emissions in all sectors except waste.

Table 4.5. Greenhouse gas emissions in 1990-2021, million tons of CO₂-eq.

Gas	1990	1995	2000	2005	2010	2015	2016	2017	2018	2019	2020	2021	Change in GHG emissions compared to 1990, %.
CO₂ (without 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
CH₄	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 O₂	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
HFC*.	NO	NO	15,7	285,1	743,9	801,6	921,4	1049,3	1395,8	1685,0	1751,5	1901,0	100,0
PFC*, **	235,8	178,1	115,7	142,3	26,7	NO	NO	NO	NO	NO	NO	NO	- 100,0
SF₆*	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
NF₃*	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	-
Net CO₂ emissions² from the LNG plant	- 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
CO₂ (with 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 LOCLG)	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

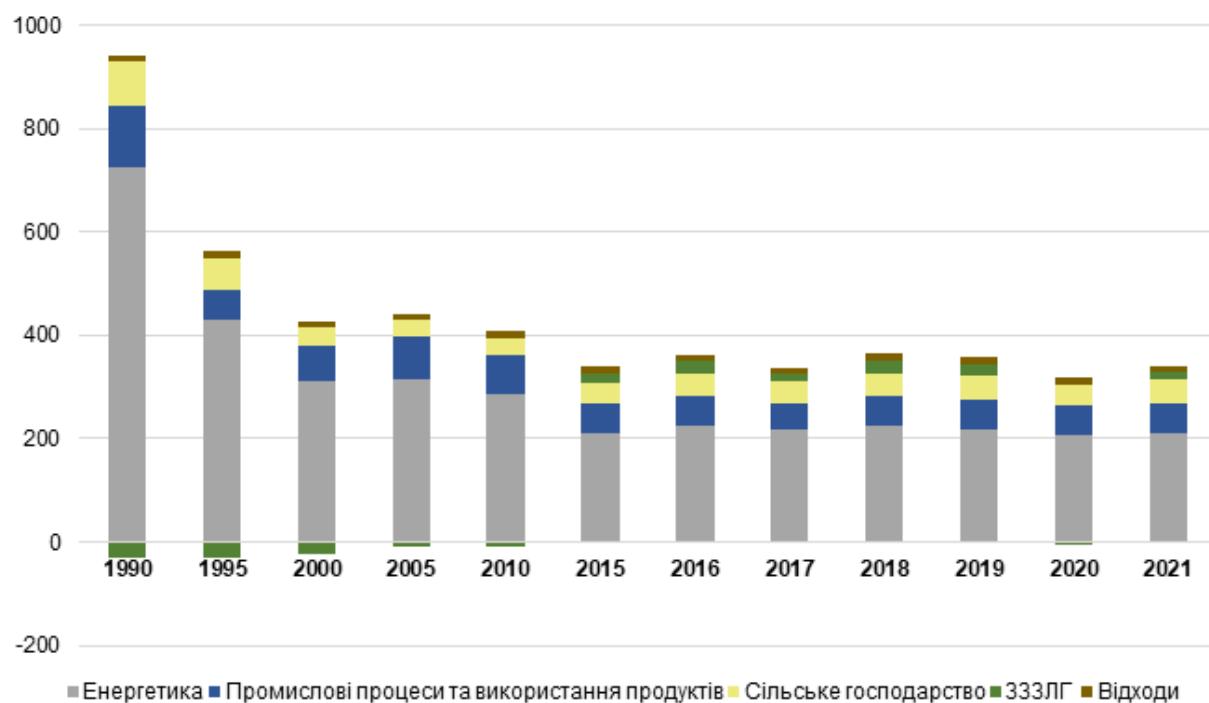
Total (including LRTLG)	911,4	530,0	405,0	433,5	398,3	338,9	362,0	336,7	364,7	357,4	317,6	341,5	- 62,5
Total (excluding LULUCF), including indirect CO₂	942,8	562,1	427,9	442,4	407,3	319,2	337,6	323,3	339,8	334,1	318,0	327,3	- 65,3
Total (with LULUCF), including indirect CO₂	911,4	530,0	405,0	433,5	398,3	338,9	362,0	336,7	364,7	357,4	317,6	341,5	- 62,5

Notes: * emissions are in thousand tons of CO₂-eq.

** no PFC emissions, as no refrigerants containing gas were imported in 2011-2021.

The energy sector is the largest source of national GHG emissions, accounting for 64% of the total, while the industrial processes and product use and agriculture sectors contribute 18% and 14%, respectively. As can be seen from Figure 4.2, the LULUCF sector has evolved from a net sink to a net emitter of GHG emissions during the period 1990-2021.

Fig. 4.2 Trends in GHG emissions and removals in 1990-2021, million tons of CO₂-eq.



GHG emissions in agriculture

In agriculture, we consider emissions of three greenhouse gases (methane (CH₄), nitrogen (I) oxide (N₂O) and carbon (IV) oxide (CO₂)), which are emitted by activities in two sectors - livestock and crop production.

Livestock production is characterized by two processes that are accompanied by emissions of mainly methane and relatively small amounts of nitrogen (I) oxide: intestinal (or enteric) fermentation of farm animals (mainly cattle); and management of farm animal manure and slurry.

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 grazing; application of nitrogen (N) with crop residues; mineralization or immobilization of nitrogen (N) associated with the movement of organic matter in the soil; cultivation of organic soils; weathering of nitrogen (N); leaching of nitrogen (N);
- SN₄ : rice cultivation;
- CO₂ : urea application; liming of soils.

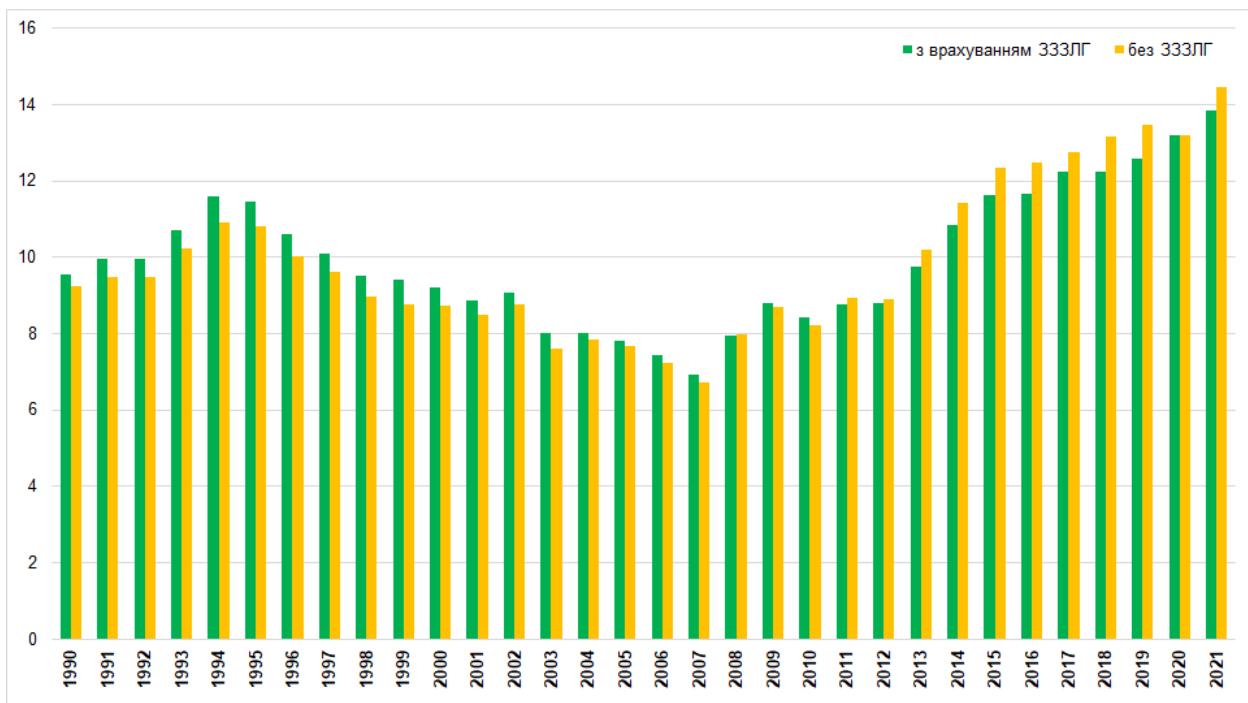
The key factors that determine the dynamics of greenhouse gas emissions in livestock production are the number of livestock and the manure management system that collects, transports, stores and uses manure. As a separate factor, the manure management system regulates greenhouse gas emissions both by the amount of manure it receives and the type of system in which it is collected, transported, stored and used. In the Ukrainian livestock sector, the following types of manure management systems are mainly used: solid storage system; liquid manure storage system; storage system in open anaerobic lagoons; aerobic treatment system; composting; manure/dung left on pasture, in pens, etc.

The crop production industry in agriculture is multifaceted, and therefore 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 soils;
application of organic fertilizers	- the amount of organic fertilizers applied to arable soils;
application of organic fertilizers from livestock grazing	- the amount of manure left on the fields of grazing animals;
N application with field crop residues	- the amount of N in plant residues (and, accordingly, 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	- the amount of N lost as a result of soil management (tillage, fertilization, plowing plant residues, etc.);
weathering N	- the amount of N applied to the soil from various sources;
leaching of N	- the amount of N applied to the soil from various sources;
rice cultivation	- the area of agricultural soils allocated for rice and the amount of organic fertilizers applied;
urea application	- the amount of urea applied to arable soils;
liming of soils	- the amount of liming materials applied.

The agriculture sector makes a significant contribution to total greenhouse gas emissions in Ukraine, which ranged from 9-14% in 1990-2021. Despite the general downward trend in greenhouse gas emissions from agricultural activities, the contribution of agriculture to total emissions is gradually increasing (Figure 4.3).

Figure 4.3. Contribution of agriculture to total GHG emissions in Ukraine, share %.



The full-scale invasion of Ukraine by the Russian Federation, which began on February 24, 2022, led to significant changes in the agricultural sector, including a reduction in the number of farm animals, a change in the ratio of manure management systems, a decrease in the amount of mineral and organic fertilizers applied, a reduction in the area of land under field crops (both sown and harvested), a decrease in gross harvest and, accordingly, yields, etc. These changes led to a reduction in greenhouse gas emissions in 2022 by almost 24% compared to the previous year (Figure 4.4).

The reduction of greenhouse gas emissions occurred in all sectors of agriculture, but the most "vulnerable" categories were "Rice cultivation" and "Agricultural soils" (Table 4.6). It should also be noted that rice cultivation is a high-tech activity carried out in the south of Ukraine, and therefore suffered the largest (both direct and indirect) impact from the hostilities in 2022.

Fig. 4.4. Total GHG emissions from agriculture in Ukraine in 1990-2022, thousand tons of CO₂-ekB

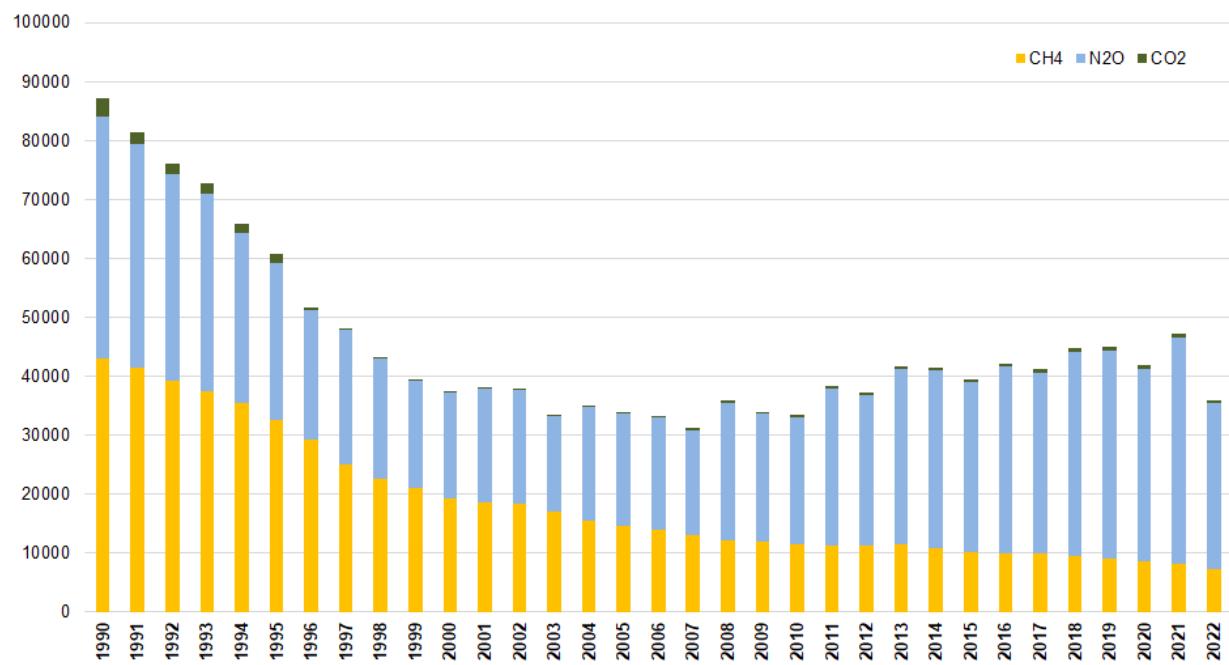


Table 4.6. Dynamics of the contribution of agricultural activities categories to greenhouse gas emissions, %.

Category	1990	1995	2000	2005	2010	2015	2020	2021	2022
Intestinal fermentation	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
Growing rice	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
Liming of soils	3,0	2,2	0,2	0,3	0,4	0,4	0,3	0,4	0,3
Adding urea	0,7	0,3	0,2	0,4	1,0	0,9	1,2	1,1	1,0

ii. Forecast of sectoral changes, taking into account existing national and allied policies and measures until 2050 (including 2030)

The table below summarizes the main results of modeling and forecasting GHG emissions in Ukraine under the scenario with existing policies and measures (WEM).

Table 4.7. Main results of modeling GHG emissions in Ukraine under the WEM scenario

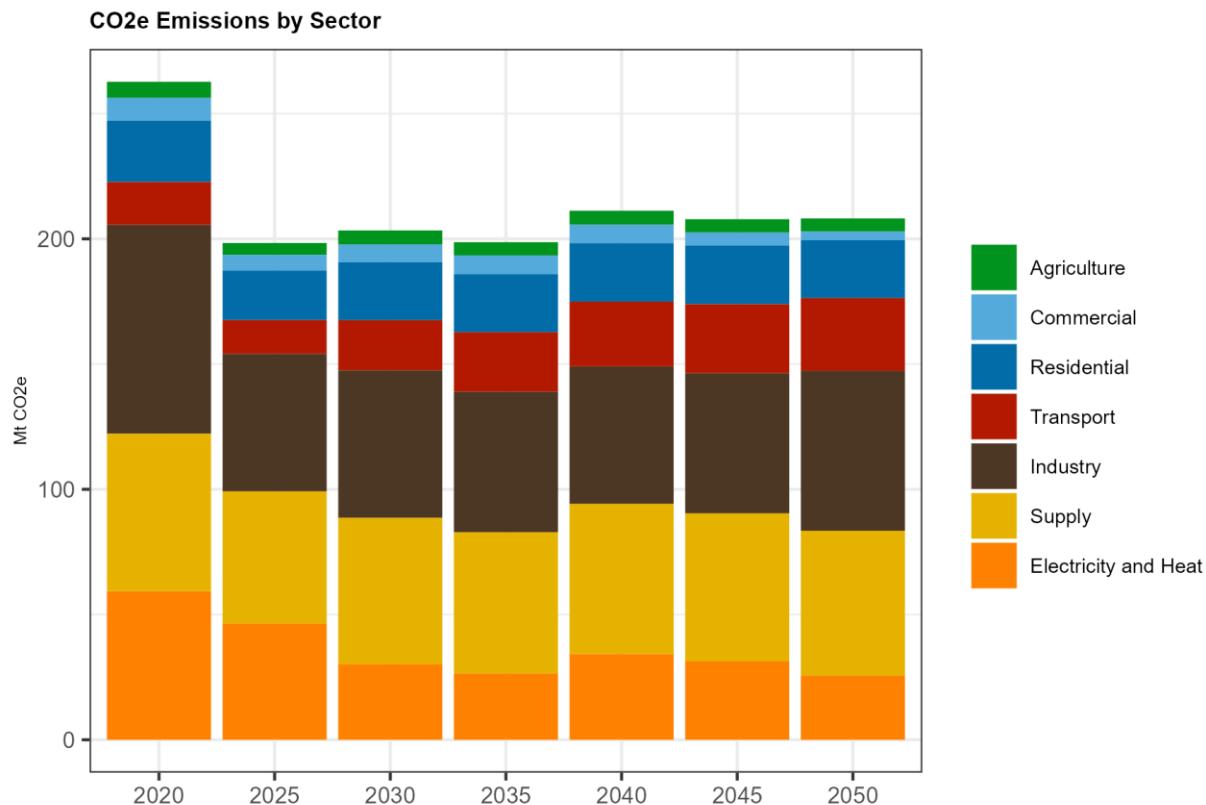
Scenario with existing policies and measures (WEM)										
	1990	2015	2020	2025	2030	2035	2040	2045	2050	
Total GHG emissions, million tons of CO₂-eq.₂	911	334	318	?	?	?	?	?	?	?
Energy, industrial processes and product use sectors	844	267	264	229	215	207	215	216	209	
Agriculture	87	39	42	37	44	48	49	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 from the 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 CO ₂ -eq per capita	17	7	8	?	?	?	?	?	?	
Carbon intensity of GDP										
t CO ₂ -eq./1,000 USD GDP (at PPP)	1,6	1,0	0,9	?	?	?	?	?	?	

Greenhouse gas emissions in the Energy and Industrial Processes and Product Use sectors

The figure below shows the forecast of GHG emissions in the Energy and Industrial Processes and Product Use sectors (as defined by the UN Intergovernmental Panel on Climate Change (IPCC)) under the scenario with existing policies and measures (WEM) until 2050, obtained using the TIMES-Ukraine economic and mathematical model that describes all energy flows in the country.

The modeling results show that even the rapid recovery of Ukraine's economy in the post-war period, without the introduction of additional energy efficiency measures and policies, the expansion of renewable energy sources, other decarbonization measures and technological modernization of the energy sector, but following the "build back better" approach, can occur without increasing GHG emissions in the Energy and Industrial Processes and Product Use sectors.

Fig. 4.5. Greenhouse gas emissions in the Energy and Industrial Processes and Product Use sectors under the WEM scenario, CO₂-eq.



Under the WEM scenario, GHG emissions in these sectors could be reduced by almost 20% by 2030 compared to 2020, after which, without additional measures, they could stabilize by 2050 at about 25% of the 1990 GHG emissions in these sectors.

Greenhouse gas emissions in the Agriculture sector

Greenhouse gas emissions are estimated for the purpose of forecasting their volume in accordance with the methodological recommendations of the Intergovernmental Panel on Climate Change (IPCC) Guidelines for National Greenhouse Gas Inventories³⁶⁴. The drivers for the forecast were key factors of agricultural activity.

The key factors agreed with the Ministry of Agrarian Policy and Food of Ukraine for 2030, 2040 and 2050 are developed taking into account a set of conditions (Annex 2), namely: cessation of hostilities (both current active and further confrontation with periodic escalation); restoration of agricultural facilities (restoration of destroyed/damaged livestock farms; demining of pastures, hayfields, arable and other lands; restoration/replenishment of the mechanized component of agricultural activities, etc.

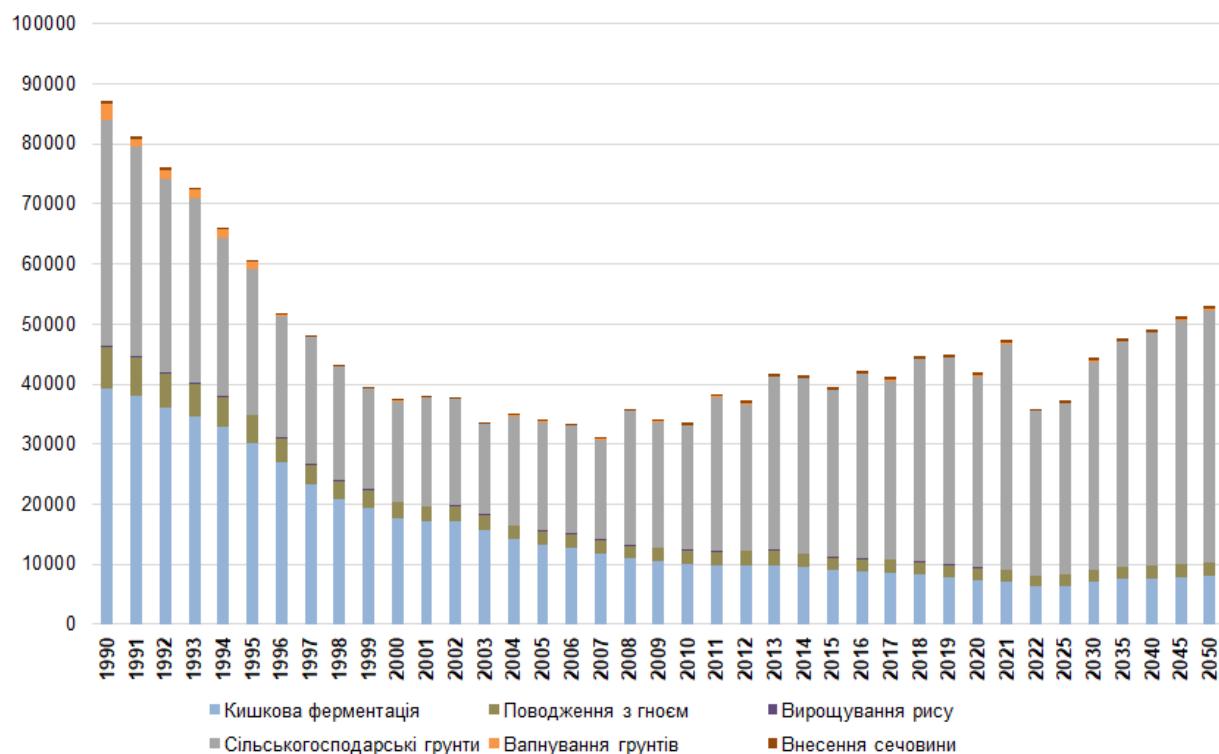
The assessment of greenhouse gas emissions in different areas of agricultural activities in accordance with the projected baseline data (Fig. 4.6) indicates that GHG emissions under the WEM scenario will amount

³⁶⁴ <https://www.ipcc-nngip.iges.or.jp/public/2006gl/index.html>

to 44366.1 thousand tons of CO₂-екв, 49178.6 thousand tons of CO₂-екв and 53092.3 thousand tons of CO₂-екв in 2030, 2040 and 2050, respectively.

Thus, the WEM scenario, which is based on the current (limited) level of implementation of the current legislation, which implies a significant delay between policy formulation, adoption and implementation, will provide a slight increase in greenhouse gas emissions. Compared to the base year of 1990, the projected greenhouse gas emissions in 2030, 2040, and 2050 will be 50.9%, 56.4%, and 60.9%, respectively.

Fig. 4.6. Projected emissions from agricultural activities in Ukraine under the WEM scenario, thousand tons of CO₂-екв



Greenhouse gas emissions in the Waste sector

The WEM scenario is based on the data of the current waste management system in Ukraine as of 2022, based on general cross-sectoral macroeconomic and socio-demographic forecasts. This scenario assumes that the current key regulatory documents in the field of waste management, namely: The National Waste Management Strategy of Ukraine until 2030³⁶⁵ and the National Waste Management Plan until 2030³⁶⁶; will be partially implemented in 2030. Full implementation of the above documents will take place gradually over the entire forecast period. This scenario takes into account that the Sustainable Development Goals in Ukraine³⁶⁷ will be achieved by 2030, including: reducing the share of untreated wastewater, increasing the specific consumption of food products, reducing the specific consumption of water resources by GDP, etc. It also corresponds to the implementation of the provisions of the Updated Nationally

³⁶⁵ <https://zakon.rada.gov.ua/laws/show/820-2017-%D1%80#Text>

³⁶⁶ <https://zakon.rada.gov.ua/laws/show/117-2019-%D1%80#Text>

³⁶⁷ <https://zakon.rada.gov.ua/laws/show/722/2019#Text>

Determined Contribution of Ukraine by 2030³⁶⁸ (hereinafter - the INDC) and takes into account the implementation of measures to implement Ukraine's climate policy as part of participation in the Global Methane Pledge³⁶⁹. In more detail, the WEM scenario envisages a reduction in the share of solid waste disposal to 70% by 2030 and 30% in 2050; an increase in the share of landfill gas utilization to 15% in 2030 and 36% in 2050; 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 values typical for EU countries; utilization of methane generated during wastewater treatment will reach 41% in 2030 and 70% in 2050; specific water consumption per unit of GDP in 2050 will decrease to 0.5 compared to 2015. The methodology for developing the WEM scenario, estimating GHG emissions and capital investments in the Waste sector is presented in Annex 3.

Unfortunately, achieving a landfill share of 30% of total solid waste generation in 2030 (defined as one of the main targets in the National Waste Management Strategy for Ukraine until 2030 and the National Waste Management Plan until 2030) is not a realistic goal. This is due to a number of causal processes: the full-scale invasion of Ukraine by the Russian Federation in early 2022, the adoption of the new modern Law of Ukraine "On Waste Management"³⁷⁰ 3-4 years later than expected, the 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 implementation for the period up to 2030 will ensure the necessary trend of GHG emission reductions in the Waste sector, which was set during the development and approval of the NERP of Ukraine.

The list of key waste management policies under the WEM scenario is presented in Table 4.8 below. The detailed ways of implementing these solid waste management policies are defined in the National Waste Management Plan 2030.

³⁶⁸ <https://zakon.rada.gov.ua/laws/show/868-2021-%D1%80#Text>

³⁶⁹ <https://zakon.rada.gov.ua/laws/show/607-2023-%D1%80#Text>

³⁷⁰ <https://zakon.rada.gov.ua/laws/show/2320-20#Text>

Table 4.8. Key policies and measures in the Waste sector under the WEM scenario

№	Name of the key policy	Quantitative indicator		
		2021/2022 (statistical information)	2030	2050
1	Promote the practice of reusing MSW components	1,5 %* (a, 2022)	8 %* (full realization)	10 %*
2	Spreading the practice of solid waste recycling	5,5 %* (a, 2022)	10 %* (partial realization)	34 %*
3	Promote the practice of composting organic components of solid waste	1,2 %* (a, 2022)	5 %* (partial realization)	16 %*
4	Spreading the practice of thermal treatment of solid waste (with the production of useful energy)	1,7 %* (a, 2022)	7 %* (partial realization)	10 %*
5	Increase the volume of landfill gas utilization (recovery and flaring) at landfills and waste dumps	9,2 %** (б, 2021)	15 %** (the quantitative indicator is not explicitly established by law)	36 %**
6	Implementation of methane utilization (recovery and flaring) at wastewater treatment facilities	0,0 %** (б, 2021)	41 %** (the quantitative indicator is not explicitly established by law)	41 %**

(a, 2022) Analysis of the state of household waste management in Ukraine for 2022; according to the Ministry of Infrastructure³⁷¹ ;

(б, 2021) National Inventory of Anthropogenic Emissions by Sources and Removal by Sinks of Greenhouse Gases, Greenhouse Gas Emissions in Ukraine for 1990-2021; according to the Ministry of Ecology³⁷² ;

* - share of the total amount of waste generated;

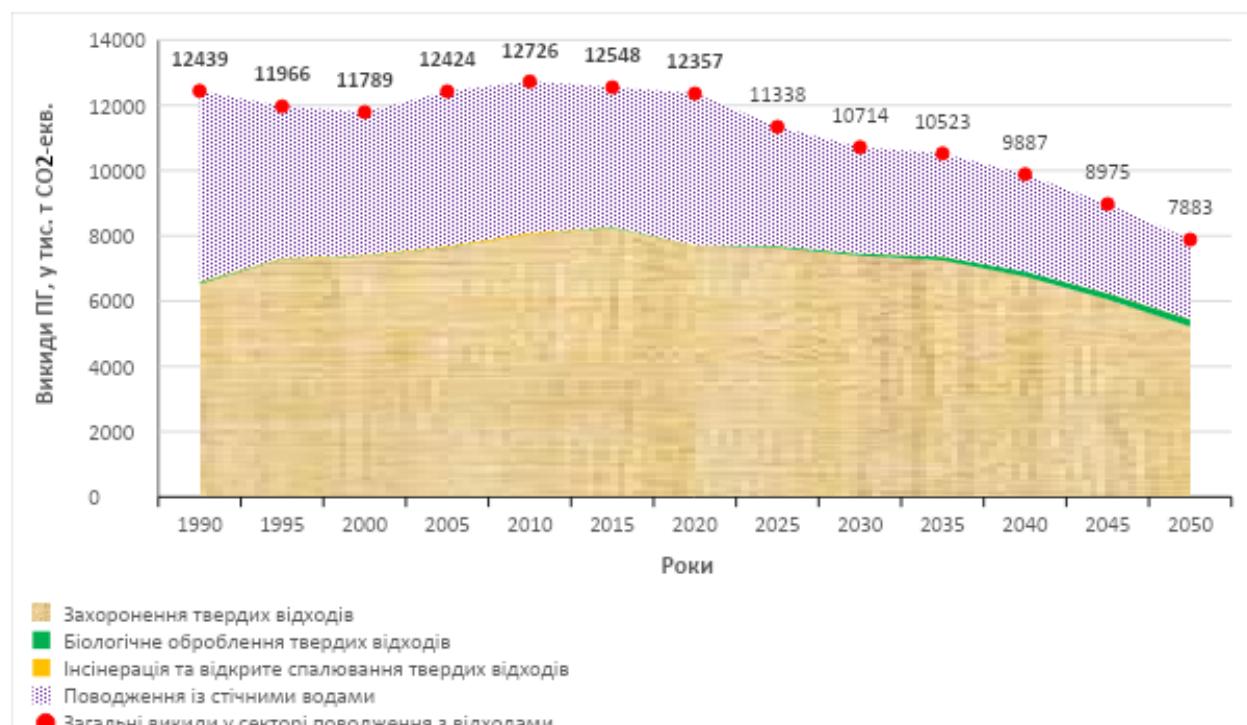
** - share of the total amount of methane produced.

According to the WEM scenario, GHG emissions in the waste management sector will be moderately reduced and in 2030 will reach 10.7 million CO₂ -eq, which is 14% lower than in 1990. Further, emissions will continue to decline and in 2050 will amount to 7.9 million tons of CO₂ -eq, which is 37% less than in 1990. Detailed GHG emissions in the waste management sector by 2050 are shown in Fig. 4.7.

³⁷¹ <https://mtu.gov.ua/news/34323.html>

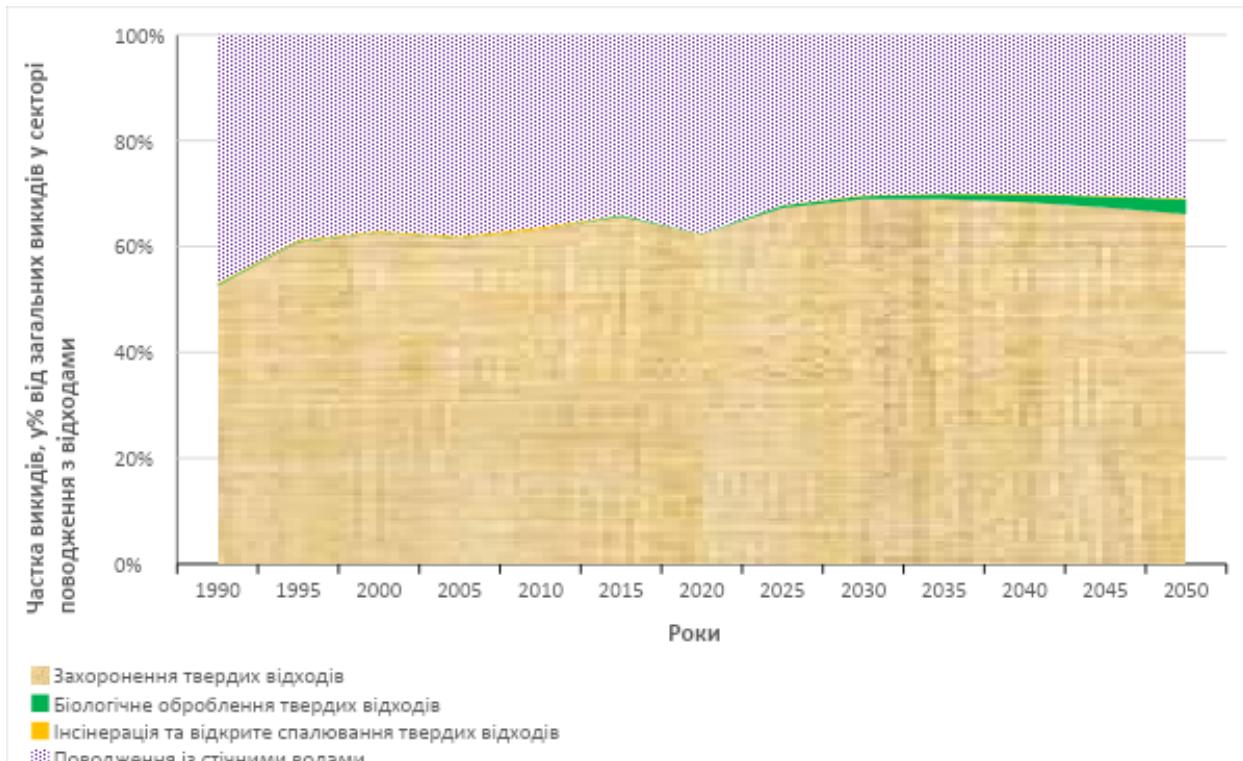
³⁷² <https://unfccc.int/documents/628276>

Figure 4.7. GHG emissions in the waste management sector under the WEM scenario; statistical data for the period 1990-2020, and projected data for the period 2025-2050



According to the WEM scenario, the structure of emissions in the waste management sector will not change significantly. Thus, solid waste disposal sites will remain the main source of GHG emissions in the sector, contributing 65% to 69%, which is slightly higher than in 2020, when it accounted for 62% of total emissions in the sector. The share of emissions related to wastewater management will remain almost unchanged, amounting to 30%-31% by 2050. The only source where GHG emissions are expected to increase is biological treatment of solid waste, with emissions from which increasing from 7.5 ktCO₂ -eq (0.1% of total sector emissions) in 2020 to 69.7 ktCO₂ eq. in 2030, and will reach 226.5 thousand tons of CO₂ eq. (2.9% of total emissions in the sector) in 2050. Such a multiple increase in emissions from biological treatment of solid waste will be caused by the intensive spread of composting of organic components of municipal solid waste (hereinafter referred to as MSW), namely food and garden waste. Greenhouse gas emissions 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 recovery of useful energy. 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 individual categories in the waste management sector by 2050 is shown in Fig. 4.8.

Figure 4.8. Structure of GHG emissions in the waste management sector under the WEM scenario; statistical data for the period 1990-2020, and projected data for the period 2025-2050



In the WEM scenario, the main factors that will determine the trends in GHG emissions in the waste management sector are:

- Moderate reduction in the share of solid waste disposal by 2050;
- moderate deployment of landfill gas flaring technologies by 2030 and intensification of landfill gas recovery by 2050;
- intensive deployment of technologies for methane recovery generated in the process of centralized wastewater treatment.

The key risks to reducing GHG emissions under the WEM scenario are:

- Critically slow implementation of methane recovery technologies at wastewater treatment plants;
- low efficiency of flaring technologies that should be introduced at landfills with low landfill gas flow rates.

4.2.2 Renewable energy

i. The current share of renewable energy in gross final energy consumption and in different sectors (heating and cooling, electricity, and transport), as well as the breakdown by technology in each of these sectors

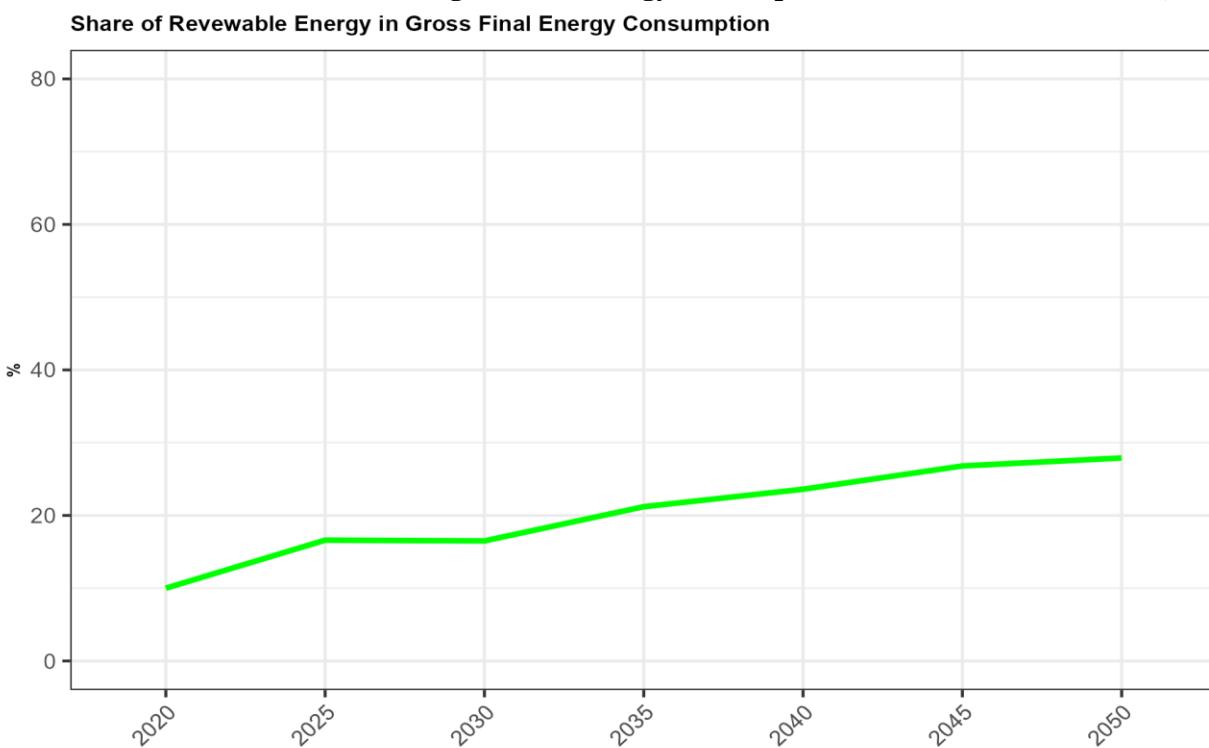
In 2020, the share of RES in the structure of gross final energy consumption was 11%. Thus, the draft NREAP envisages its growth by almost 2.5 times by 2030.

ii. Indicative forecasts of development based on existing policies until 2030 (with a view to 2050)

Given the current and potential consequences of a full-scale invasion of Ukraine by the Russian Federation, achieving the target of 27% of RES in the structure of gross final energy consumption seems extremely ambitious.

Modeling results under the WEM scenario show that the share of RES in the structure of gross final energy consumption, although it will grow steadily, will be minimal and the target in 2030 will not be achieved, primarily due to low penetration of RES in industrial energy consumption, replacement of carbon-intensive energy resources and low rates of replacement of natural gas with RES in individual heating systems in the residential and commercial sectors.

4.9. Share of RES in the structure of gross final energy consumption under the WEM scenario, %.



The table below shows the projected values of total primary energy supply (TPES), final energy consumption (FEC), electricity and heat production under the WEM scenario.

Table 4.9. Main results of modeling RES development in Ukraine under the WEM scenario

	2015	2020	2025	2030	2035	2040	2045	2050
Total primary energy supply (TPES)								
Total primary energy supply, million tons of oil equivalent.	90	86	62	75,8	78,7	79,8	79,1	80

<i>Coal, %.</i>	31	32	28	19	16	19	17	16
<i>Gas, %.</i>	29	31	29	25	25	25	25	26
<i>Crude oil, %.</i>	12	11	13	14	16	16	16	16
<i>Nuclear energy, %.</i>	26	23	20	32	31	25	24	24
<i>Hydropower, %.</i>	1	1	1	1	1	1	1	1
<i>Wind energy, %.</i>	0,1	0,2	1	1	2	3	4	4
<i>Solar energy, %.</i>	0,0	0,5	1	1	1	1	2	2
<i>Biofuels and waste, %.</i>	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, million tons of oil equivalent.	48,2	45,2	34,8	42,2	44,2	46,2	46,5	48,7
<i>Coal, %.</i>	8,4	8,1	6,6	6	3,7	4,2	2,6	5,3
<i>Gas, %.</i>	32	29	27	26	25	25	26	25
<i>Crude oil, %.</i>	20	21	21	22	24	24	23	22
<i>Thermal energy, %.</i>	17	17	18	17	17	17	17	17
<i>Electricity, %.</i>	21	21	22	23	25	25	25	25
<i>RES, %.</i>	3	2	5,8	6,1	5,7	5,4	5,6	5,8
<i>Solar energy, %.</i>	-	0,01	0,02	0,03	0,06	0,09	0,19	0,31
Share of renewables in gross TPP, %.	6,2	10,2	16	15	21	23	26	27
Electricity production								
Electricity generation, TWh	157	175	118	146,2	161	170,5	172,7	173,8
<i>Coal, %.</i>	33	33	29	13	11	18	17	13
<i>Gas, %.</i>	5	4	8	5	5	4	4	4
<i>Nuclear energy, %.</i>	56	52	41	63	58	46	43	44
<i>Biofuels and waste, %.</i>	0	0	3	3	3	1	2	3
<i>Wind energy, %.</i>	1	1	4	6	11	16	19	21
<i>Solar energy, %.</i>	0	3	7	4	5	7	8	8
<i>Hydropower, %.</i>	5	6	6	6	5	5	5	6
Share of renewable energy sources, %.	6,0	10,6	20	19	24	29	34	37
Heat production (heat supply stations)								
Heat production (heat supply plants), million tons of oil equivalent	9,5	9,4	7,4	8,2	8,7	8,8	9,3	9,7
<i>Coal, %.</i>	15,8	13,7	13,7	16,8	16,9	17,7	17	14,5
<i>Gas, %.</i>	61,5	60,1	58,6	50,6	44,6	46	48,2	47,7
<i>Biofuels and waste, %.</i>	7,4	11,5	18,3	20,1	27,8	26,5	25	27,2
<i>Crude oil, %.</i>	0,2	0,2	0,2	0,2	0,2	0,2	0,2	0,2
<i>Electricity, %.</i>	3	3	3	3	3	3	3	3
Share of renewable energy sources, %.	15,3	18,5	27,2	26,1	33,8	32,7	30,2	32,3

4.3. Dimension "Energy efficiency"

i. Current indicators of primary and final energy consumption in the economy and by sector (including industry, residential, services and transportation)

As of 2020, final energy consumption amounted to 47.8 million toe (excluding the temporarily occupied territory of the Autonomous Republic of Crimea and the city of Sevastopol and part of the temporarily occupied territories in Donetsk and Luhansk regions). A significant decrease in final energy consumption occurred in 2014 (by 12.4%) due to a number of factors: the occupation of the Crimean peninsula and a large part of industrial zones in Donetsk and Luhansk oblasts, economic downturn, energy supply restrictions, and rising energy prices. In 2016 and 2018, final energy consumption increased due to structural factors: economic recovery and normalization of energy supply to consumers. This growth in final energy consumption, accordingly, affected the growth of primary energy consumption in these years. As of 2020, primary energy consumption amounted to 82.7 million toe.

Fig. 4.10. Dynamics of changes in primary and final energy consumption, 2013-2020

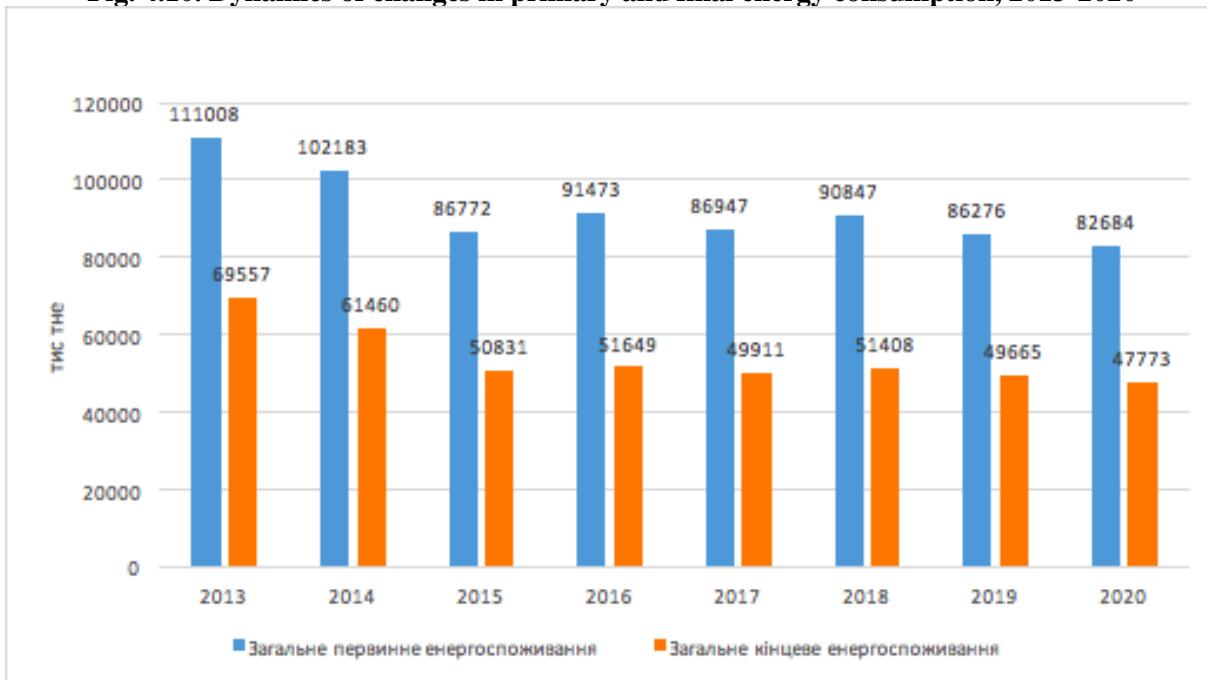
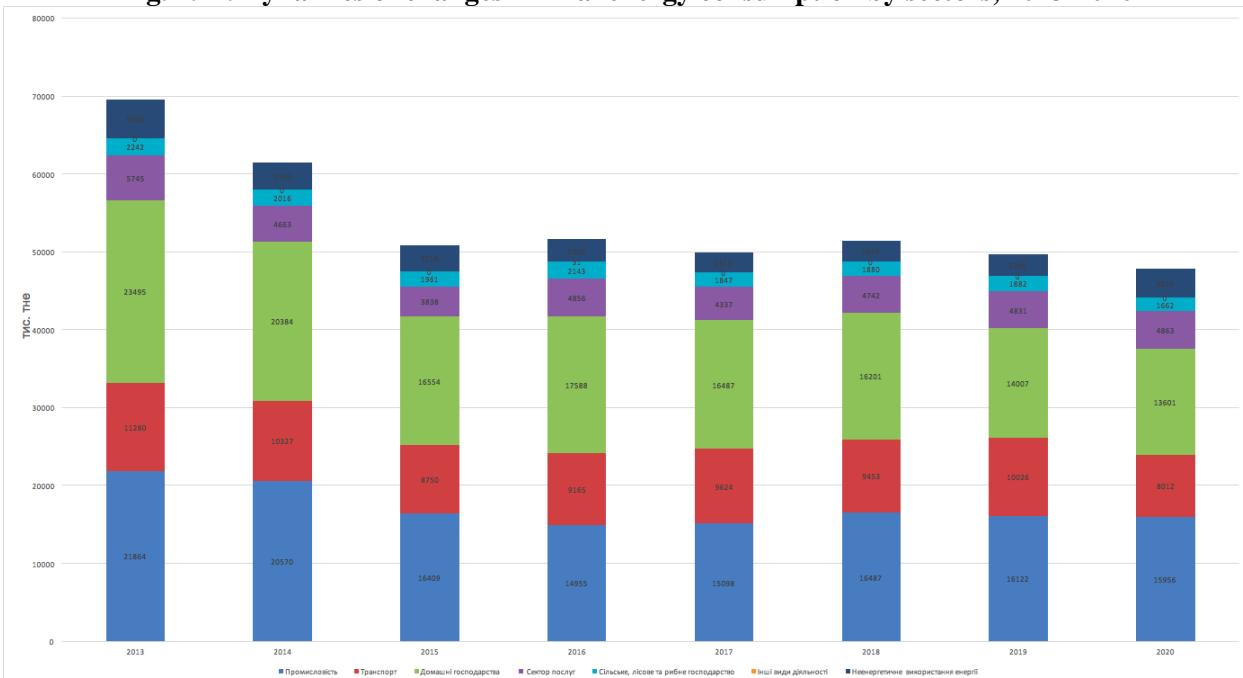


Fig. 4.11. Dynamics of changes in final energy consumption by sectors, 2013-2020



*For 2014-2021, excluding the temporarily occupied territory of the Autonomous Republic of Crimea and the city of Sevastopol and part of the temporarily occupied territories in Donetsk and Luhansk regions.

Source: State Statistics Service

In 2020, industry accounted for the largest share of final energy consumption (33.4%). The second largest energy consumer was the residential sector, with a share of 28.5%. The transport sector consumed 16.8% of energy, the services sector - 10.2%, non-energy consumption - 7.7%, agriculture, forestry and fisheries - 3.5%.

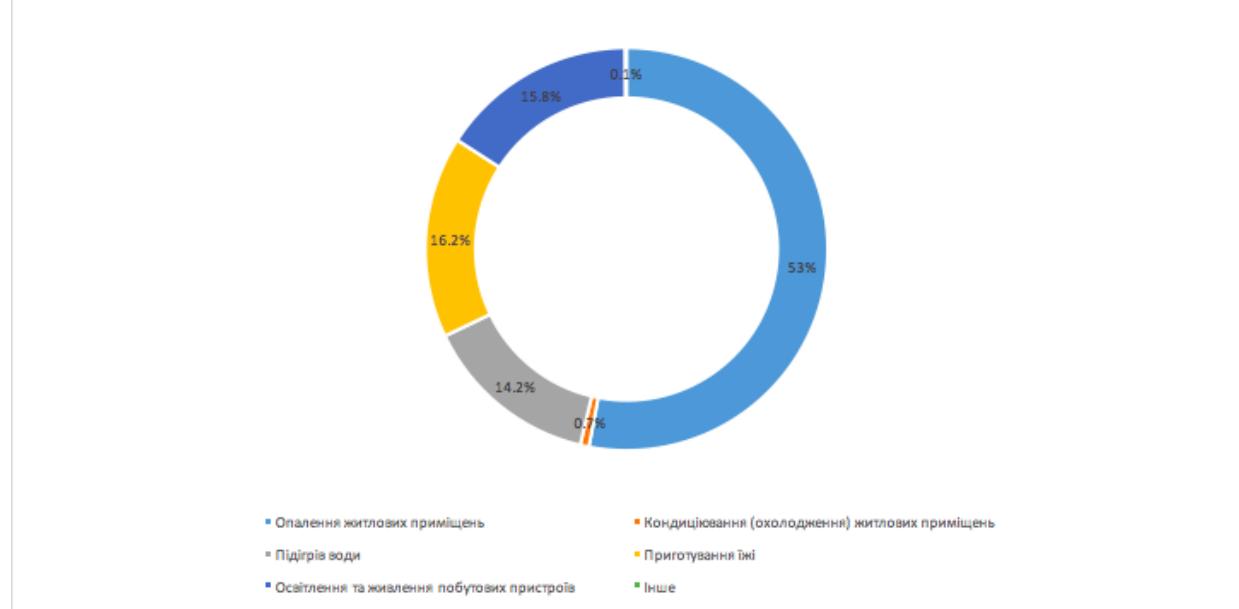
Fig. 4.12. Final energy consumption by sector, 2020*.



Source: State Statistics Service

In the structure of final energy consumption by households, the largest share is heat supply (53%). Cooking uses 16.2% of energy, lighting and power supply for household appliances - 15.8%, water heating - 14.2%.

Figure 4.13. Structure of final energy consumption by households by purpose, 2020



Source: State Statistics Service

State statistics on final energy consumption for 2021-2022 are not available as of the end of 2023. According to government statements, the full-scale invasion of Ukraine by the Russian Federation resulted in a 30-35% decrease in energy consumption compared to 2021.

In the first year of hostilities, the residential sector suffered the most (38% of the total damage), followed by transportation (26%), energy (8%), trade and industry (8%), and agriculture (6%)³⁷³. The World Bank estimates that up to 1.4 million residential units (apartments); 135,000 individual houses; and up to 39,040 residential units (rooms) in dormitories were destroyed or damaged. Donetsk, Kharkiv, Luhansk, Kyiv, and Mykolaiv regions suffered the most damage. It is estimated that more than one third of all damaged housing units (499,056 housing units) have been destroyed.

Public buildings have also suffered significant damage. As of February 24, 2023, at least 2,772 educational institutions were partially damaged (454 destroyed), which together accounts for approximately 10% of all educational institutions (all educational levels) in Ukraine. the Russian Federation continues to target educational institutions in 2024. 15.9% of public healthcare facilities (1,574 institutions) were damaged or destroyed.

Destruction in the industrial sector has a significant impact on changes in final energy consumption. According to the Kyiv School of Economics, as of September 1, 2023, the losses of industry and enterprises include at least 426 large and medium-sized private enterprises and state-owned companies that were damaged or destroyed as a result of the hostilities³⁷⁴. The metallurgy sector suffered the most: Azovstal and Ilyich Iron and Steel Works in Mariupol, the second and third largest metallurgical plants in Ukraine, were destroyed.

Along with the destruction of housing and infrastructure, Ukraine has also experienced a significant population decline. According to the Institute of Demography, as of January 1, 2023, the population of Ukraine ranged from 28 million to 34 million people³⁷⁵, 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)³⁷⁶. The UN records 6.2 million officially registered refugees from Ukraine as of October 2023.³⁷⁷

Large-scale destruction, structural changes in the economy and population decline will have a decisive impact on changes in final energy consumption. At the same time, it is expected that the restoration of destroyed buildings, infrastructure and industry will be based on the principle of "build back better," which will result in a reduction in energy consumption.

ii. Current potential for the use of highly efficient cogeneration and efficient district heating and cooling

As of the end of 2023, no assessment of the potential for the use of high-efficiency cogeneration and efficient district heating and cooling in accordance with the requirements of Directive 2012/27/EU has been made.

The results of modeling the scenario with existing policies and measures (WEM) using the TIMES-Ukraine model show that cogeneration of electricity and heat at CHPs will remain at more than 50% throughout the model period (Figure below), while NPP production may increase slightly, given the development of nuclear power, which is also cogeneration, but with a small share of heat.

³⁷³<https://documents1.worldbank.org/curated/en/099062823034041908/pdf/P18017401fe8430010af21016afb4ebc8c4.pdf>

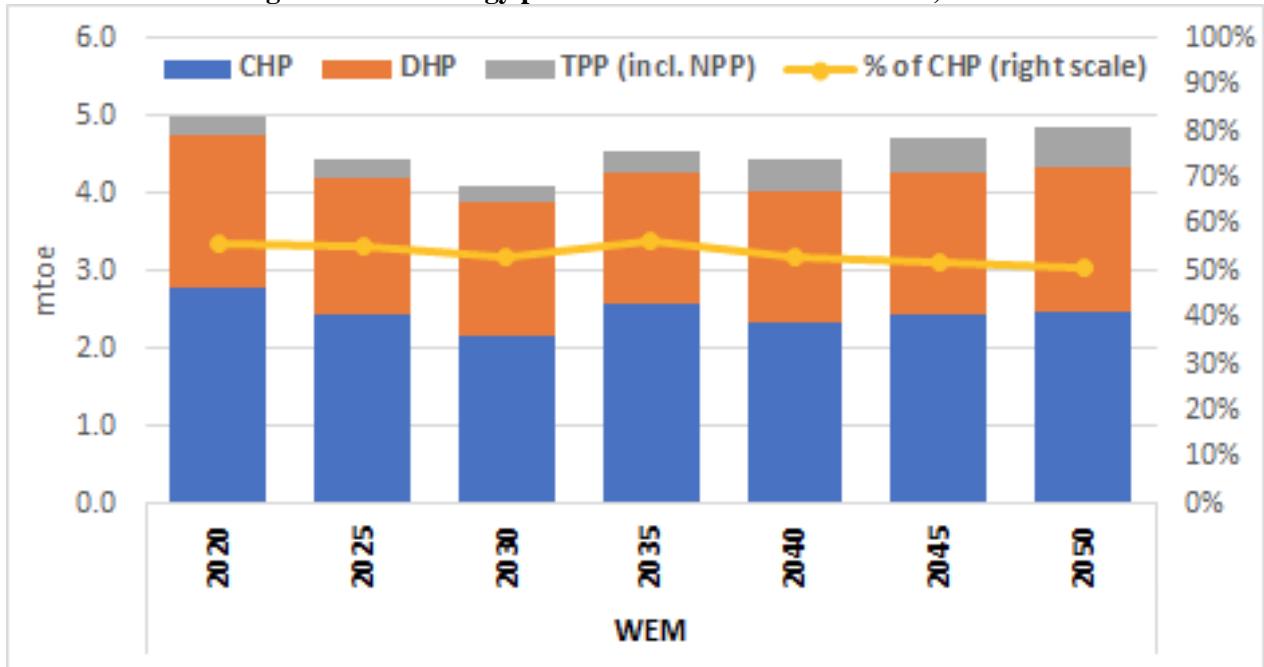
³⁷⁴<https://kse.ua/ua/about-the-school/news/zagalna-suma-pryamih-zbitkiv-zavdana-infrastrukturi-ukrayini-cherez-viynu-syagaye-151-2-mlrd-otsinka-stanom-na-1-veresnya-2023-roku/>

³⁷⁵<https://voxukraine.org/fejk-za-chas-vijny-naselennya-ukrayiny-skorotylosya-do-20-miljoniv>

³⁷⁶<https://www.ukrstat.gov.ua/>

³⁷⁷<https://data.unhcr.org/en/situations/ukraine>

Fig. 4.14. Heat energy production in the WEM scenario, Mtoe.

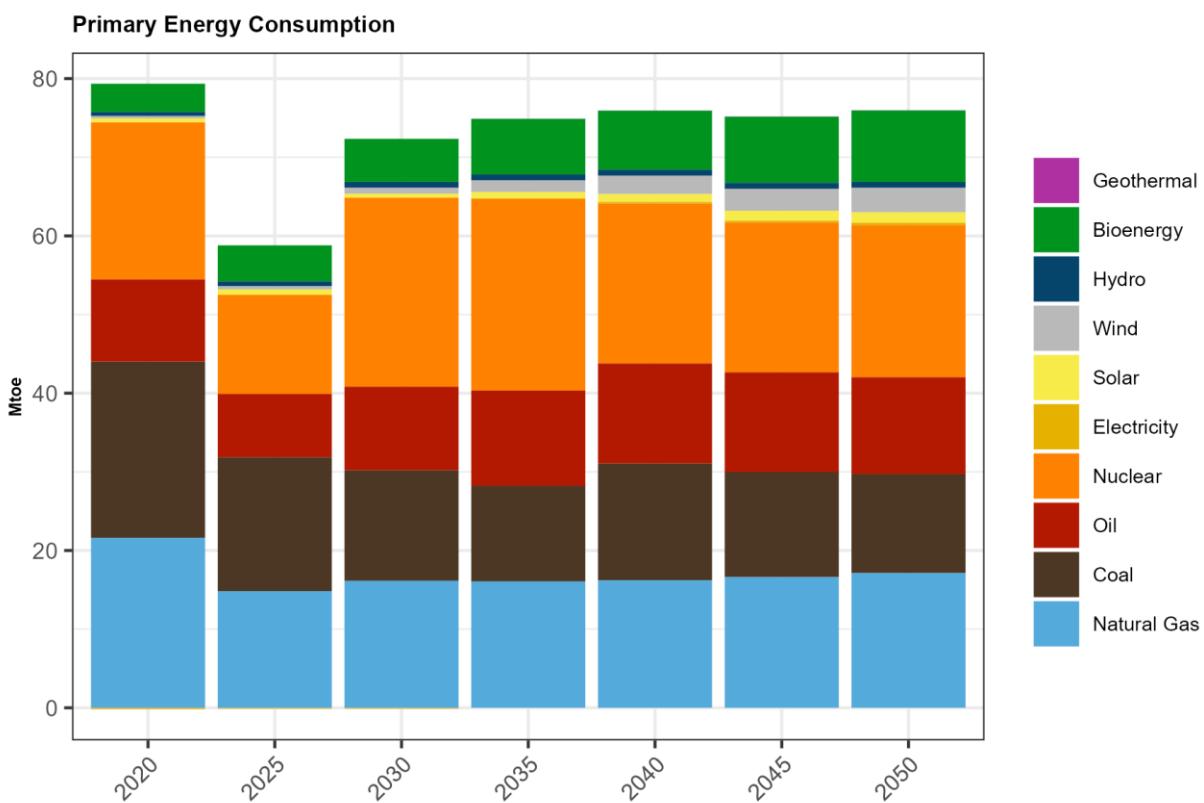


iii. Forecasts, taking into account existing energy efficiency policies, measures and programs as described in paragraph 1.2.(iii), for primary and final energy consumption in each sector by 2050 (including 2030)

The results of the WEM scenario modeling confirm, and this is logical even without modeling, that the post-war economic recovery and reintegration of the temporarily occupied territories of Ukraine will contribute to a significant increase in energy demand - especially in the first 5-10 years.

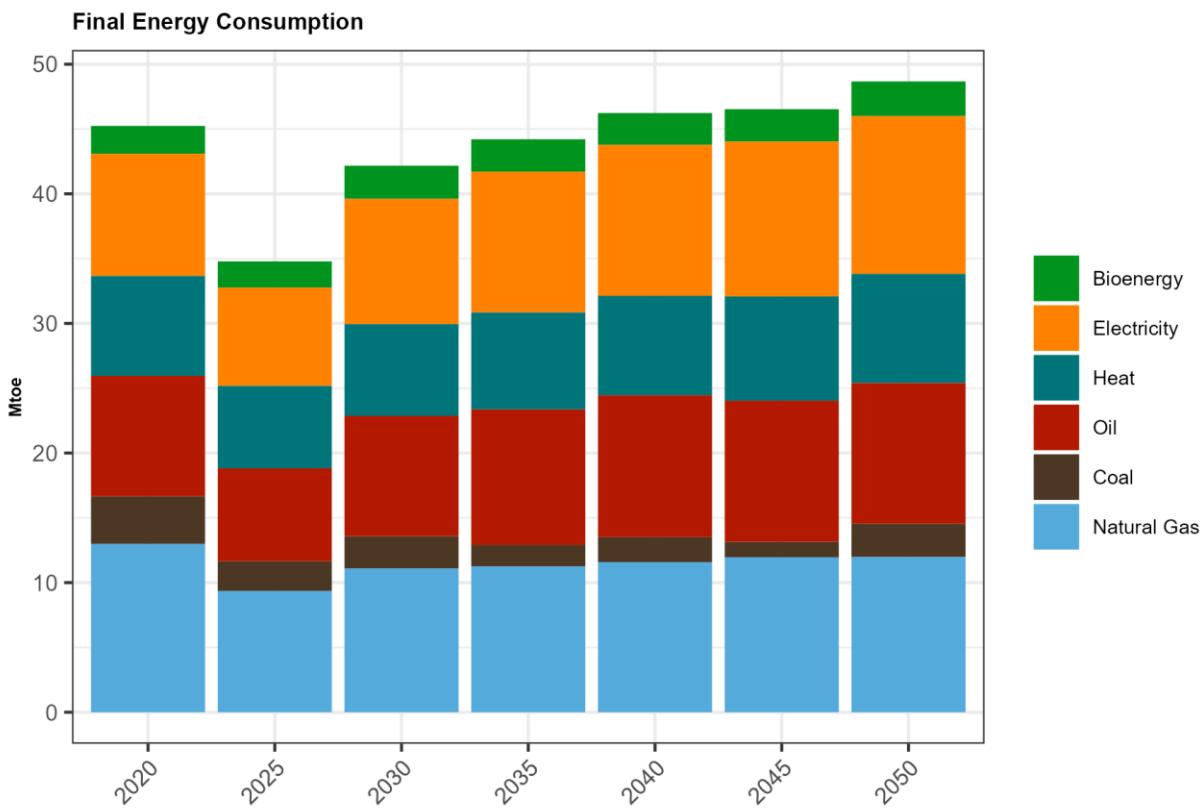
At the same time, existing measures and policies in the field of energy efficiency and renewable energy will barely ensure stabilization of primary energy consumption (PEC) after the post-war recovery. Nevertheless, the growth of primary energy consumption will not increase significantly in the WEM scenario, and this growth will be ensured primarily by increasing consumption of renewable energy sources and nuclear energy (Figure below).

4.15. Primary energy consumption in the WEM scenario, million toe.



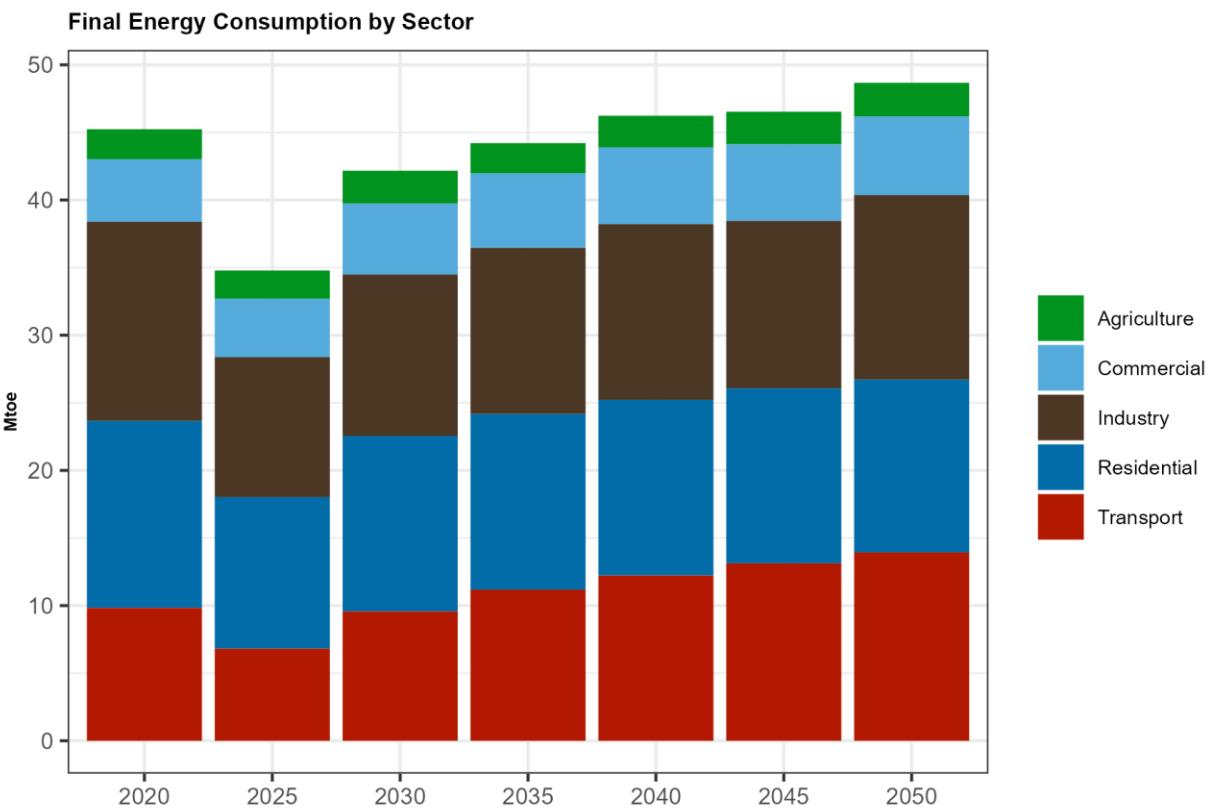
The dynamics of final energy consumption (FEC) is similar to the dynamics of TFC, but in the WEM scenario, the growth rate of FEC is slightly higher than the growth rate of TFC due to increased electricity consumption, which indicates an increase in the efficiency of the energy transformation sector.

4.16. Final consumption by energy type in the WEM scenario, Mtoe.



After a radical drop in energy consumption in 2022 as a result of the full-scale invasion of Ukraine by the Russian Federation, all CE sectors will see an increase in energy demand until 2030, driven by economic recovery and the reintegration of the temporarily occupied territories, which will continue beyond 2030.

4.17. Final energy consumption by sector in the WEM scenario, Mtoe



The results of modeling final energy consumption by sector and fuel type in Ukraine are presented in the table below.

Table 4.10: Final energy consumption by sectors and fuel types, million toe.

	2015	2020	2025	2030	2035	2040	2045	2050
Final energy consumption in the service sector								
ECE in the services sector, million tons of oil equivalent.	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
Thermal 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
RES	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								
CES in industry, million tons of oil equivalent.	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

<i>Thermal energy</i>	16,6	16,2	16,6	18,1	19,5	19,3	20,4	19,1
<i>Electricity</i>	27,4	27,1	29,6	33,8	39,2	41	44,6	40,8
<i>RES</i>	0,5	0,5	1	1,9	2,5	2,7	3,1	3,2
Final energy consumption in the residential sector								
CES in the residential sector	16,6	13,8	11,2	13	13	13	13	12,8
<i>Coal</i>	2	1	0	1	1	1	1	1,1
<i>Gas</i>	55,5	48,8	51,3	52,9	54,8	56,9	59,7	62,9
<i>Oil</i>	0,1	0,2	0	0	0	0,8	0,7	0
<i>Thermal energy</i>	17,5	14	12,7	13,4	13,2	12,9	12,7	12,5
<i>Electricity</i>	18,5	21,9	21,1	22,1	22,6	22,5	22,2	22,1
<i>RES</i>	6,6	14,1	15	10,7	8,3	5,9	3,6	1,5
<i>Solar energy</i>	0	0	0	0,1	0,1	0,1	0,2	0,5
Final energy consumption in the transportation sector								
CES in the transportation sector, million tons of oil equivalent.	10	9,8	6,8	9,6	11,1	12,2	13,1	14
<i>Coal</i>	0,05	0,1	0,1	0,1	0,1	0,1	0,1	0,1
<i>Gas</i>	14,7	16,5	8,7	10,1	8,7	11,3	12,9	13,4
<i>Oil</i>	75,7	75,7	82,4	79,5	79,6	76,2	70,8	67,3
<i>Electricity</i>	8,9	7,2	8,1	9,5	10,8	11,6	11,1	11,4
<i>RES</i>	0	0	0	0,2	0,3	0,3	4,5	7,2
Final energy consumption in agriculture								
CES in agriculture, million tons of oil equivalent.	2,3	2,3	2,2	2,5	2,3	2,4	2,5	2,5
<i>Coal</i>	0,6	0,6	0,6	0,6	0,6	0,6	0,6	0,6
<i>Gas</i>	8,5	8,5	8,4	8,5	8,4	8,3	8,1	7,9
<i>Oil</i>	60,5	60,5	60,8	60,7	60,9	59,3	57,5	55,1
<i>Thermal energy</i>	14,2	14,2	14,2	14,2	14,2	14,3	14,4	14,5
<i>Electricity</i>	15	15	14,7	14,9	14,8	14,8	14,8	14,9
<i>RES</i>	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 according to national calculations in accordance with [Article 5](#) of Directive 2010/31/EU

The minimum requirements for energy efficiency of buildings are established on the basis of data calculated for reference buildings, taking into account the requirements for thermal performance of building envelopes and energy efficiency of engineering systems (including equipment) of buildings, in accordance with the economically feasible level, taking into account the cost of discounted total costs of implementing energy efficiency measures relative to the estimated service life of each reference building, and are differentiated depending on the function of the building.

- For new construction and 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.
- When reconstructing or overhauling buildings as a whole or their separate parts, the minimum requirement is to meet the condition:

$$EP_{use} \leq 1.2 \times EP_p, \quad (1)$$

Where EP_{use} - total specific energy consumption for heating and cooling, kWh/m^2 , (kWh/m^3), calculated according to the [Methodology for determining the energy efficiency of buildings](#);

EP_p - is the limit value of specific energy consumption for heating and cooling of residential and public buildings, kWh/m^2 , (kWh/m^3), which is shown in Table 5 below.

- When reconstructing or overhauling parts of the building (individual envelope structures as a whole) specified in the design documentation, the minimum requirement is to meet the condition:

$$R_{\Sigma np} \geq R_{q min}, \quad (2)$$

Where $R_{\Sigma np}$ - is the reduced heat transfer resistance of the building envelope, $\text{m}^2 \times \text{K/W}$, determined in accordance with DBN B.2.6-31:2016 "Thermal insulation of buildings" (hereinafter - DBN B.2.6-31);

$R_{q min}$ - is the minimum allowable value of heat transfer resistance, $\text{m}^2 \times \text{K/W}$, determined in accordance with DBN B.2.6-31.

Table 4.11. Limit values of specific energy consumption for heating and cooling of residential and public buildings

No. s/n	Type of building (reference buildings)	Limit value of specific energy consumption of buildings for heating and cooling, EP_p , kWh/m^2 [kWh/m^3], for the temperature zone of Ukraine	
		I	II
1	Residential buildings (number of storeys):		
	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 storeys):		
	from 1 to 3	[38Λ _{bci} + 15]	[34Λ _{bci} + 13]
	from 4 to 9	[30]	[25]
	10 and more	[25]	[20]
3	Certain types of public buildings:		
	3.1 Hotel buildings	57Λ _{bci} + 60	50Λ _{bci} + 55
	3.2 Buildings of educational institutions	[55Λ _{bci} + 24]	[52Λ _{bci} + 23]
	3.3 Buildings of preschool education institutions	[32]	[28]
	3.4 Buildings of healthcare facilities	[30]	[26]
	3.5 Commercial buildings	[33Λ _{bci} + 17]	[26Λ _{bci} + 15]

Note: Λ_{bci} is the building compactness coefficient, m^{-1} , calculated according to DBN B.2.6-31:2016 "Thermal insulation of buildings".

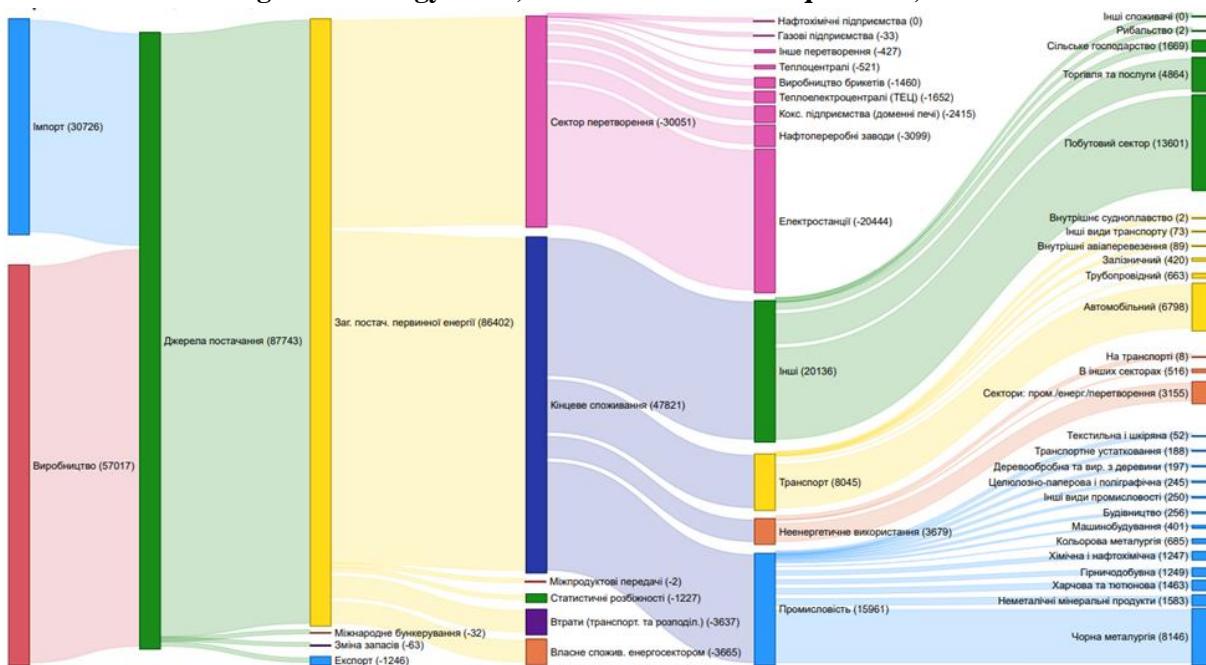
4.4. Dimension "Energy security"

i. Current energy balance, own energy resources, dependence on imports, including relevant risks

In recent years, the total primary energy supply in Ukraine has been at the level of 86-93 million toe, 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 improvement of energy conversion and consumption efficiency.

At the same time, imports were fairly stable. As of 2020, imports amounted to 30.7 Mtoe, 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.

Fig. 4.18. Energy flows, thousand tons of oil equivalent, 2020

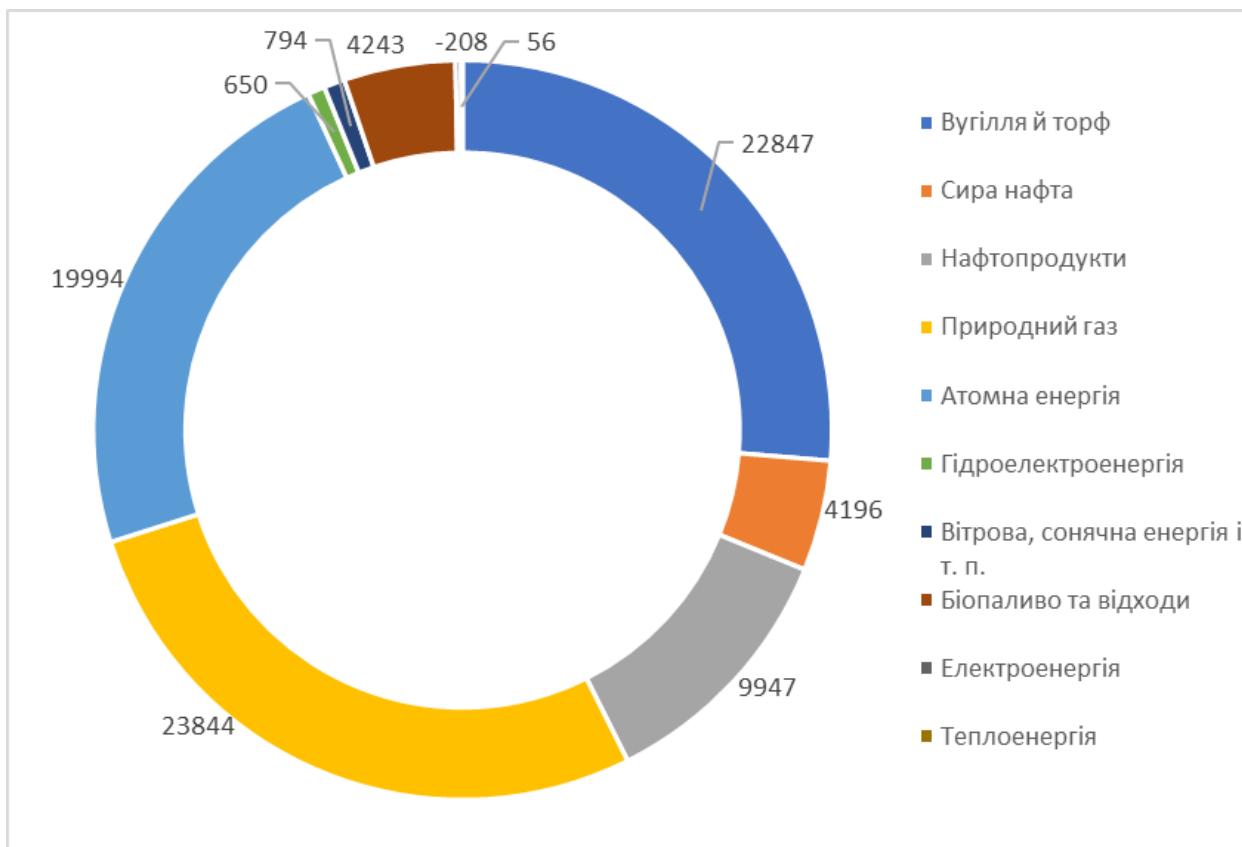


Source: State Statistics Service of Ukraine³⁷⁸

According to the Energy Balance 2020, Ukraine's current energy mix includes four main energy sources covering almost 90% of TPEC: coal (26.5%), natural gas (27.6%), nuclear energy (23.2%), and oil products (11.5%). The share of renewable energy sources, including hydropower, is 6.6%.

³⁷⁸ https://www.ukrstat.gov.ua/operativ/operativ2020/energ/drpeb/graf_u.zip

Figure 4.19. Energy balance of Ukraine in 2020



Source: State Statistics Service of Ukraine³⁷⁹

Despite the decline in net imports in the 1990s and 2000s in absolute terms, which has stabilized in the last 5 years, the dynamics of self-sufficiency in energy resources varies by individual energy resources.

For example, there was a significant decline in the provision of coal and peat resources from 98.5% in 2013 to 55.8% in 2020. This is largely due to the loss of control over mining enterprises in the territories occupied by the Russian Federation, as well as to the further decline in production of state-owned mines. According to the State Customs Service, in 2022, Ukraine reduced imports of hard coal and anthracite by 4.2 times (by 14 million 932.904 thousand tons) compared to 2021 - to 4 million 630.144 thousand tons³⁸⁰.

Similar dynamics were observed in the supply of crude oil, which amounted to 59% in 2020. But even this relatively satisfactory figure only takes into account the demand of Ukrainian refineries, and if we take into account the motor fuel market, according to the Energy Balance (product) for 2017 (the latest complete production data), imports accounted for almost 64% of domestic supply for gasoline, 87% for gas oil/diesel, and 75% for liquefied petroleum gas. According to the State Customs Service, Ukraine imported 7 million 300,073 thousand tons of petroleum products in 2022, which is 17% less than in 2021 (8 million 790,515 thousand tons)³⁸¹.

The situation with natural gas has improved significantly. The self-sufficiency rate increased from 40.6% in 2013 to 66.5% in 2020. The main factors were the stabilization of production, despite the loss of resources

³⁷⁹ https://www.ukrstat.gov.ua/operativ/operativ2021/energ/drpeb/EBTS_2021_ua.xls

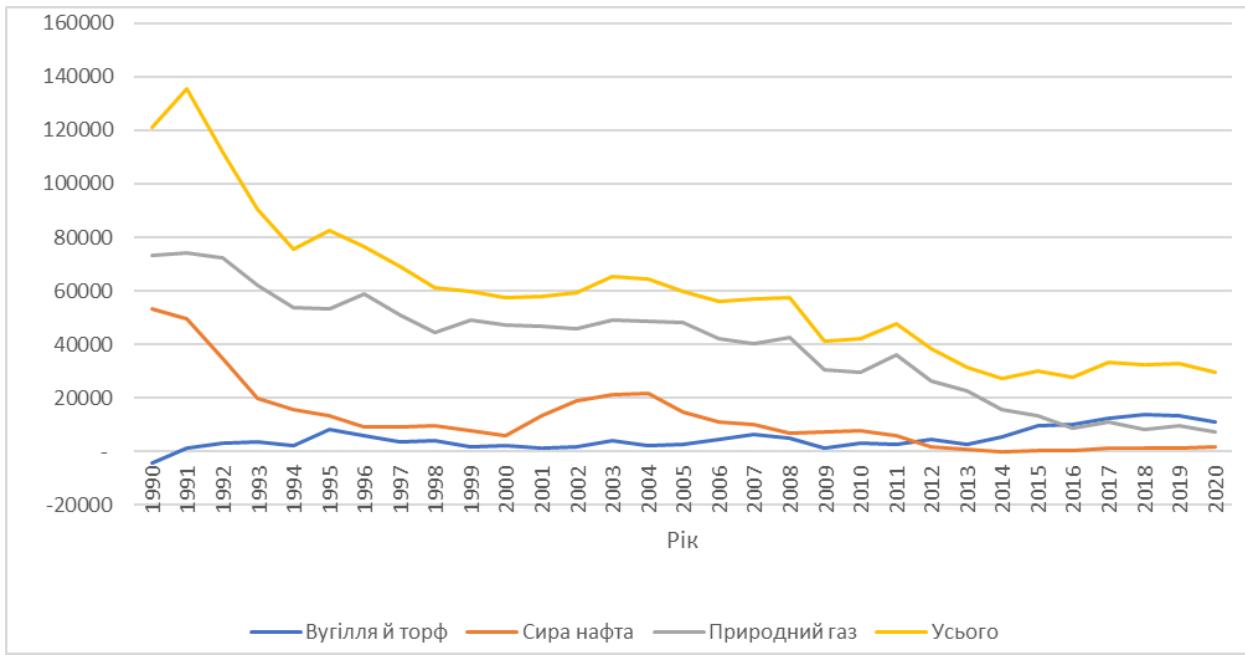
³⁸⁰ <https://ua-energy.org/uk/posts/ukraina-u-sichni-skorotyla-import-naftoproduktiv-ta-vuhillia>

³⁸¹ <https://ua-energy.org/uk/posts/ukraina-u-sichni-skorotyla-import-naftoproduktiv-ta-vuhillia>

in the occupied territories (in particular, the Black Sea shelf) and low investment in new drilling, as well as a significant reduction in consumption in both the industrial and domestic segments. According to industry data, total gas consumption in 2022 decreased by 31% to 19.8 bcm, while production amounted to 18.5 bcm.

In terms of nuclear fuel, Energoatom decided to stop importing Russian products in favor of Westinghouse, and from 2025 it plans to provide itself with 50% of its own products.

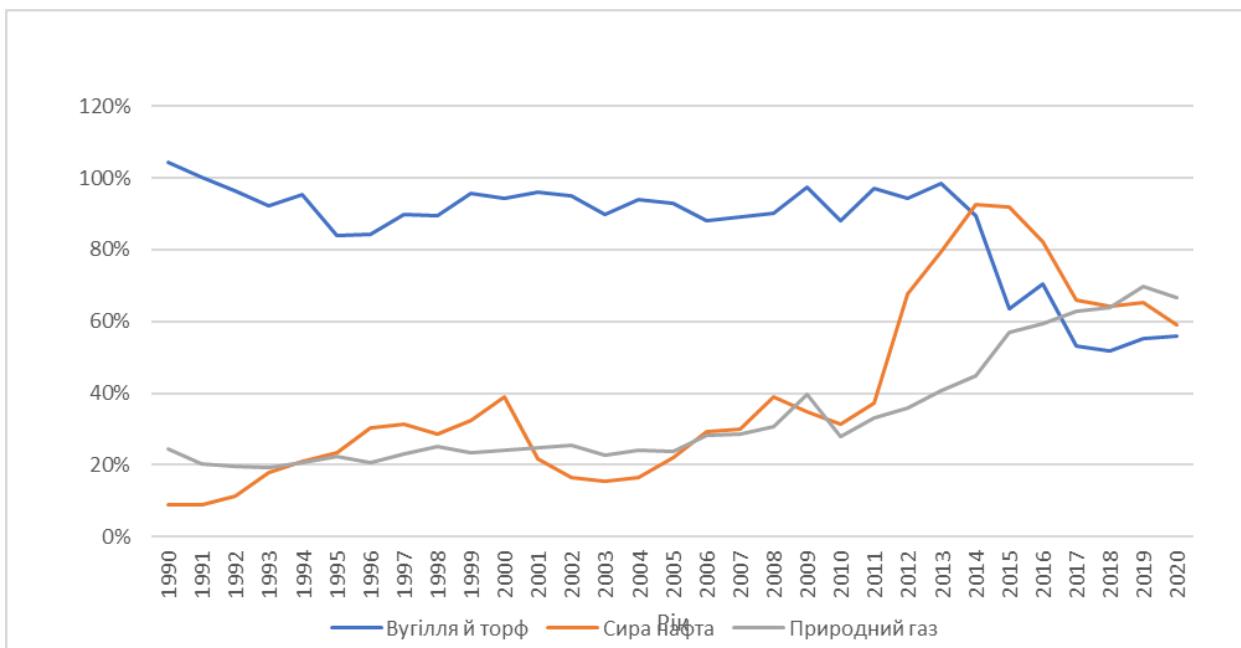
Figure 4.20. Net energy imports, thousand tons of oil equivalent.



Source: State Statistics Service of Ukraine³⁸²

³⁸² https://www.ukrstat.gov.ua/operativ/operativ2021/energ/drpeb/EBTS_2021_ua.xls

Figure 4.21. Provision of Ukraine's economy with own resources, %.



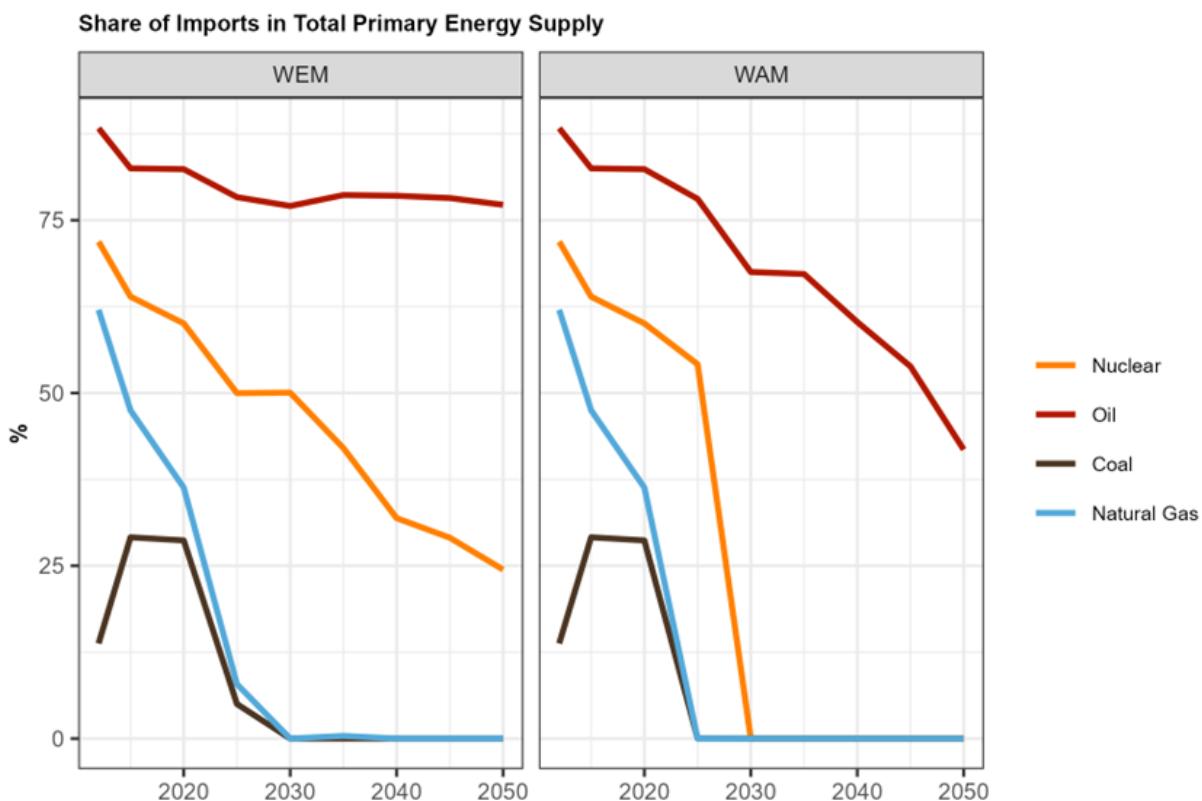
Source: State Statistics Service of Ukraine³⁸³

ii. Development projections based on existing policies and measures until at least 2040 (including 2030)

Under the WEM and WAM scenarios, dependence on oil and oil products imports still remains a challenge. Due to falling demand for natural gas, increased production, as well as energy efficiency and the development of renewable energy sources, dependence on natural gas imports can be overcome by 2030. The same applies to uranium ore.

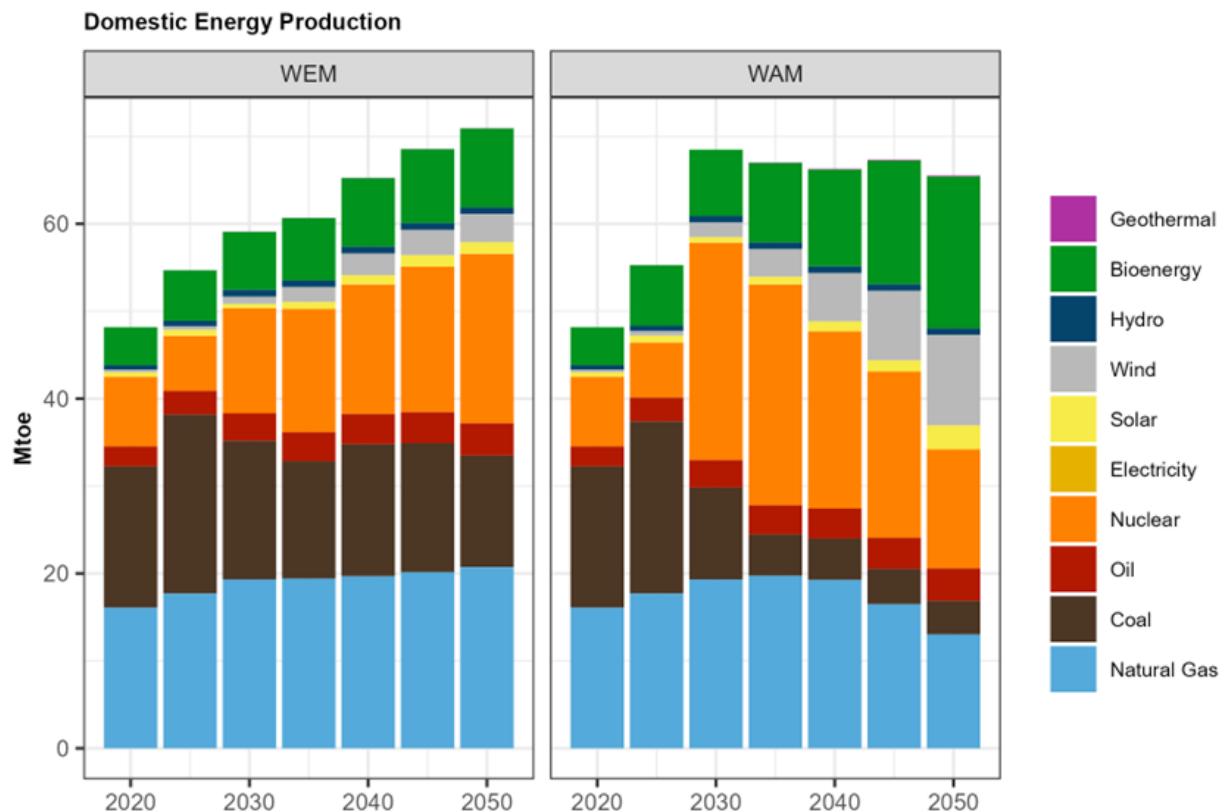
³⁸³ https://www.ukrstat.gov.ua/operativ/operativ2021/energ/drpeb/EBTS_2021_ua.xls

Figure 4.22. Forecast of Ukraine's own energy resources, %.



Under both WEM and WAM scenarios, energy production is projected to grow. By 2030, uranium ore production shows the largest increase, while by 2035, steam coal production will significantly decrease. By 2050, bioenergy production may increase 10-fold, while wind and solar energy will cover one-third of energy needs.

Figure 4.22. Forecast of energy resources production and supply, million tons of oil equivalent.



4.5. Dimension "Domestic energy market"

4.5.1. Integration of energy systems

i. Current level of integration and main interconnectors

Ukraine has direct electricity connections with ENTSO-E countries and Moldova. Until February 24, 2022, there were two separate trading zones due to the technical characteristics of Ukraine's power system: "Burshtyn TPP Island" (synchronized with ENTSO-E) and "Integrated Power System of Ukraine" (synchronized with the Russian Federation and the Republic of Belarus). To test the power system stability in preparation for integration with the ENTSO-E power systems, the IPS of Ukraine was disconnected from the systems of the Russian Federation and the Republic of Belarus on February 24, and the internal systems (trading zones) were synchronized. Since March 16, 2022, the IPS of Ukraine's single trading zone has been operating synchronously with the ENTSO-E interconnection of the power systems of continental Europe.

"Ukrenergo can transmit electricity through interstate crossings 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 capacity of the internal crossings of the IPS of Ukraine), the amount of electricity flow between the IPS of Ukraine and the power system of Moldova can be up to 400 MW, but during peak hours it is limited to 260 MW, and during repair work on adjacent 330 kV OHLs - to zero).

In 2023, Ukraine switched to the unified European rules for access to interstate lines for electricity exporters and importers. Market participants receive access to the capacity of Ukraine's interstate power grids based on the results of explicit auctions held by the auction office of the transmission system operator Ukrenergo³⁸⁴ jointly with the TSOs of neighboring EU countries. In the future (until the spot electricity markets are coupled with the neighboring EU countries - market coupling), most joint coordinated auctions for the allocation of access to interstate cross-border crossings of Ukraine 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 Approval of the Rules for Allocation of Capacity of the Ukraine-Poland, Ukraine-Slovakia and Ukraine-Hungary Interstate Crossings"³⁸⁵.

Prior to the emergency synchronization of the IPS of Ukraine with the ENTSO-E power systems on March 16, 2022, the annual volume of electricity transmission was up to 7 TWh (5 TWh through the Burshtyn Island cross-border sections, up to 2 TWh was transmitted via the 220 kV Dobrotvirska TPP-Zamosc transmission line). According to Ukrenergo's estimates, the additional transmission volume, provided that the Khmelnytska NPP-Rzeszów and South Ukrainian NPP-Isakcha cross-border power lines are restored, could amount to up to 16 TWh per year. That is, the annual volume of electricity transmission from Ukraine to ENTSO-E countries can reach up to 30 TWh.

Table 4.10: Interstate power transmission lines of the IPS of Ukraine (as of 2021)

Country.	Number of transmission lines by voltage class (kV), pcs.						
	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
Total connections with ENTSO-E countries	3	3	7	3	12	2	1

* The Khmelnytska NPP-Rzeszów line was switched to a lower voltage class (from 750 kV to 400 kV).

After synchronization with the IPS of Ukraine, ENTSO-E decided on June 7, 2022 to gradually expand the authorized capacity for electricity imports/exports. Commercial exchanges of electricity with the EU countries at the minimum level began on June 30, 2022 (the authorized export capacity was 100 MW). Subsequently, during July 2022 - November 2023, there was a gradual increase in the authorized capacity for electricity exports and imports. In March 2023, ENTSO-E increased the permitted technical capacity for electricity imports from the EU to Ukraine and Moldova to 700 MW, in April - to 850 MW, in May - to 1050 MW,³⁸⁶ in June - to 1200 MW³⁸⁷.

³⁸⁴ <https://eap-office.ua.energy/pages/dashboard>

³⁸⁵ <https://zakon.rada.gov.ua/rada/show/v1683874-23#Text>

³⁸⁶ <https://www.entsoe.eu/news/2023/04/19/further-increase-in-the-trade-capacity-with-the-ukraine-moldova-power-system/>

³⁸⁷ <https://www.entsoe.eu/news/2023/06/21/press-release-further-increase-in-the-trade-capacity-with-the-ukraine-moldova-power-system/>

In November 2023, ENTSO-E Regional Group Continental Europe confirmed the full implementation by NPC Ukrrenergo of all technical measures of the Action Catalogue³⁸⁸, which is an integral part of the Agreement on the conditions for the future interconnection 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 authorized capacity of interconnectors for electricity imports to Ukraine and Moldova to 1700 MW³⁸⁹. This decision is based on the results of studies of the security and stability of synchronous operation of the Ukrainian and European power systems.

Further gradual increase of the allowed technical capacity for electricity imports from the EU to Ukraine/Moldova is expected in accordance with ENTSO-E decisions. The technical capacity for exports from Ukraine/Moldova to Europe is 400 MW³⁹⁰.

In addition, in March 2023, a new agreement on emergency assistance for the TSO of Ukraine came into force, which allows Ukrrenergo to request activation and the TSOs of neighboring countries to offer emergency assistance in cases of failure of generating or transmission capacities or situations of sudden imbalance between electricity supply and demand³⁹¹.

ii. Forecasts of interconnector expansion needs (including for 2030)

The ESU defines the needs for further development of the capacity of interconnectors between Ukraine and ENTSO-E countries. In particular, by 2032, the capacity of interconnectors is expected to increase to 6 GW, and by 2050 - to 10 GW in order to ensure more intensive cross-border trade in electricity and energy services.

The TSO, within the framework of the basic document assessing the prospects for the development of the electricity sector - the Report on the Assessment of the Compliance (Sufficiency) of Generating Capacities to Cover the Forecasted Demand for Electricity and Ensure the Necessary Reserve in 2023³⁹², determines the following dynamics of the development of the maximum throughput capacity of interstate crossings of Ukraine with ENTSO-E countries for the period up to 2050 (Table 4.11).

³⁸⁸ The Technical Conditions (Catalog of Measures) were enshrined in the Agreement on the Conditions for the Future Interconnection of the Power Systems of Ukraine and Continental Europe signed in 2017. The catalog contains more than 200 technical measures in 9 areas. The Catalogue of Measures is an integral part of the Framework Agreement on the Synchronous Area of the Continental Europe (SAFA), to which NPC Ukrrenergo is a party.

³⁸⁹ <https://www.entsoe.eu/news/2023/11/28/continental-european-tsos-announce-completion-of-synchronisation-project-with-ukrrenergo-and-significant-increase-in-export-capacity-from-continental-europe-to-ukraine/>

³⁹⁰ <https://ua.energy/zagalni-novyny/entso-e-zbilshyla-obsyagy-propusknosti-spromozhnosti-mizhderzhavnyh-interkonektoriv-dlya-importu-elektroenergiyi-v-ukrayinu-ta-moldovu-do-1200-mvt/>

³⁹¹ <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>

³⁹² <https://www.nerc.gov.ua/acts/pro-zatverdzhennya-zvitu-z-ocinki-vidpovidnosti-dostatnosti-generuyuchih-potuzhnostej-dlya-pokrittya-prognozovanogo-popitu-na-elektrichnu-energiyu-ta-zabezpechennya-neobhidnogo-rezervu-u-2023>

Table 4.11. Possibilities for the development of interstate crossings for electricity export/import (NTC), GW

Capacity of interstate crossings (by scenarios)	Years				
	2024	2030	2035	2040	2050
Optimistic	1,7	4,8	5,0	5,0	5,1
Pessimistic	1,7	4	4,8	4,8	4,8

4.5.2. Energy transmission infrastructure

i. Key characteristics of the existing electricity transmission and gas transportation infrastructure

Electricity infrastructure

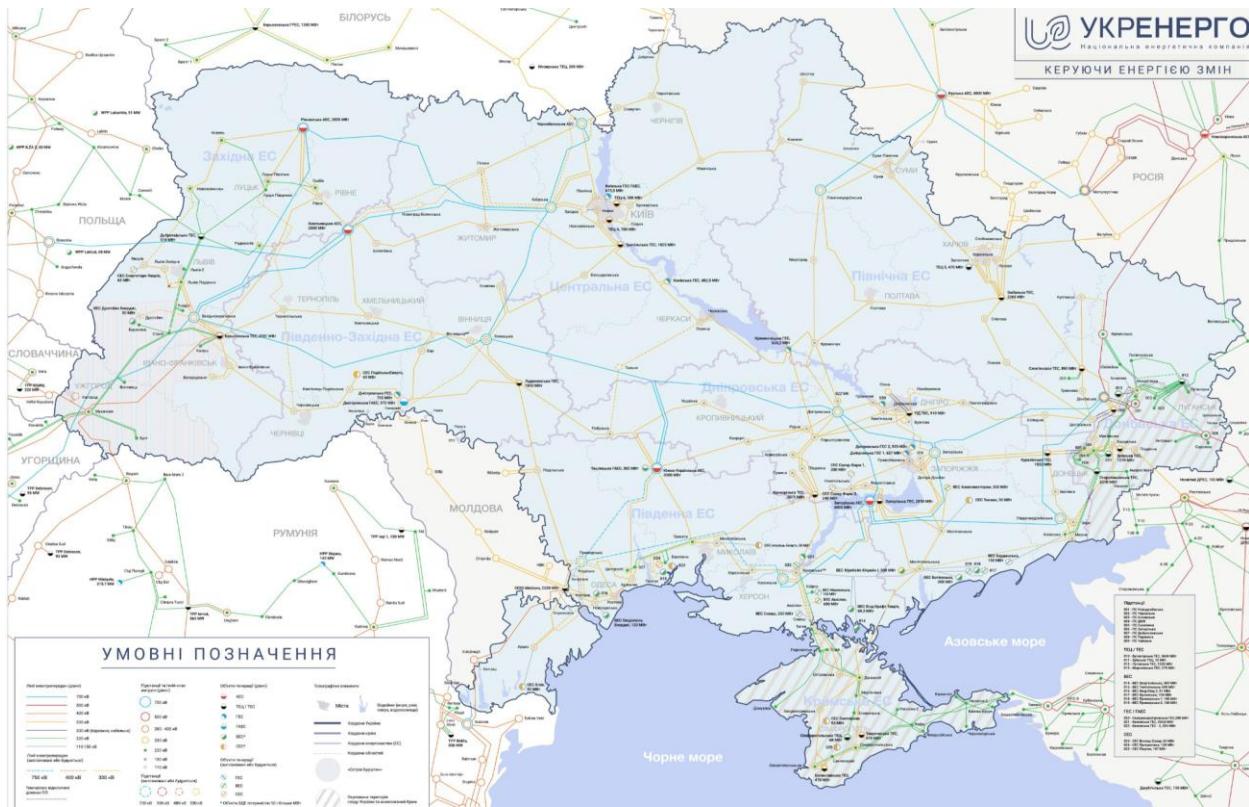
The Integrated Power System of Ukraine (IPS) is a set of power plants, power grids, and other electric power facilities united by a common mode of electricity generation, transmission, and distribution under centralized management. The IPS of Ukraine is the backbone of the country's electricity sector, which provides centralized electricity supply to domestic consumers, interacts with the power systems of neighboring countries, and ensures electricity exports and imports. It combines generating capacities and distribution networks of the regions of Ukraine, which are interconnected by backbone power transmission lines of 220-750 kV (power transmission system).

The IPS of Ukraine is one of the largest power systems in Europe; it includes 6 regional power systems and 32 distribution system operators. The transmission system operator (TSO) NPC Ukrrenergo performs dispatch (operational and technological) control, maintains the balance in the IPS of Ukraine and organizes parallel operation with the power systems of ENTSO-E member countries.

The system-forming grids with a voltage of 220-750 kV include trunk and interstate power grids (electricity transmission system). They ensure the supply of electricity from powerful power plant units and its subsequent transmission to the distribution networks of Ukraine's regions (electricity distribution systems), as well as export and import connections with the power systems of neighboring countries. Power transformation is ensured by means of 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 01.01.2021, the TSO operated 21,861.6 km of overhead lines (OHL) on the route and 23,559.1 km on the circuits.

According to the Transmission System Development Plan for 2022-2031, as of the beginning of 2021, the TSO had 141 substations (SS) with a voltage of 110-750 kV and a transformer capacity of 83,178.1 MVA. Of these, 33 are 220 kV, 88 are 330 kV, 2 are 400 kV, 3 are 500 kV, 9 are 750 kV, and 6 are 110 kV (solar power plant substations). The electricity distribution system included more than 1 million km of overhead and cable power lines with a voltage of 0.4-150 kV and about 200 thousand transformer substations with a voltage of 6-150 kV.

Map of the IPS of Ukraine (as of the beginning of 2021)



The main equipment installed in the transmission system, which operates in a continuous mode and determines the reliability and efficiency of operation, was mainly manufactured in 1950-1970. In terms of its main technical characteristics (weight and dimensions, reliability and efficiency indicators, etc.), it is inferior to modern equipment and requires more and more repairs. This situation significantly affects the increase of electricity losses in the transmission system and limits the possibility of preventing technological disruptions - damage to electrical equipment or disruption of its performance, which leads to disruption of normal and reliable operation of power plants of electricity facilities and the IPS of Ukraine as a whole.

Technological losses of electricity in the trunk and interstate grids amount to about 2%. The objective reasons why losses in the IPS of Ukraine remain at a fairly high level include the following:

- transmission of electricity over long distances, especially for distribution networks;
- unsatisfactory technical condition of power grids due to the use of worn-out equipment.

The TSO substations operate major equipment with long service lives (Table 4.12).

Table 4.12. Service life of the main equipment (as of 01.01.2021)

Name of the equipment	Capacity, MVA	Number of units, units.	Including in operation, units.			
			up to 25 years old	from 25 to 30 years old	from 30 to 40 years old	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
Circuit breakers (35-750 kV)	-	3 326	1 134	260	777	1 115

According to the data presented in Table 4.13, 20,792 km of overhead transmission lines in the TSO have been in operation for more than 30 years (88.0% of the length of all lines), of which 16,344 km have been in operation for more than 40 years (69.4% of the length of all lines). These data indicate a trend of further aging and insufficient reconstruction of overhead lines, which leads to complications in their operation by the TSO.

Table 4.13. Lifetime of overhead power lines by voltage class (as of 01.01.2021)

Voltage class	Total, km		Including those in operation (by chains), km			
	along the highway	in chains	up to 25 years old	from 25 to 30 years old	from 30 to 40 years old	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
Together	21 861,6	23 559,1	2 298,6	468,5	4 447,7	16 344,3

Due to changes in climatic conditions in recent decades, a significant number of power transmission lines built in the 1970s and 1980s are vulnerable to increased climatic loads. This is largely manifested in the autumn and winter period in the southern and northern regions of Ukraine (Southern, Dnipro, and Northern power systems). Increased loads and the effects of storm winds, ice, vibration, and wire galloping have significantly increased the number of damaged overhead line elements and accelerated their wear. As a result, there is a need for a fundamental technical re-equipment and reconstruction of the overhead lines in these regions and in general, as the design life (40 years) of most of them has already expired.

The need to reconstruct 220 kV OHLs of the IPS of Ukraine remains urgent, as most of them have already exceeded 50 years of service life. The annual plans provide for repairs of the foundations of metal towers, reinforced concrete towers, replacement of lightning protection cables, porcelain insulation, and other works aimed at ensuring the reliability of OHLs. At the same time, due to the accelerated aging of the overhead lines and the impact of increased loads, these works require more material and labor costs every year.

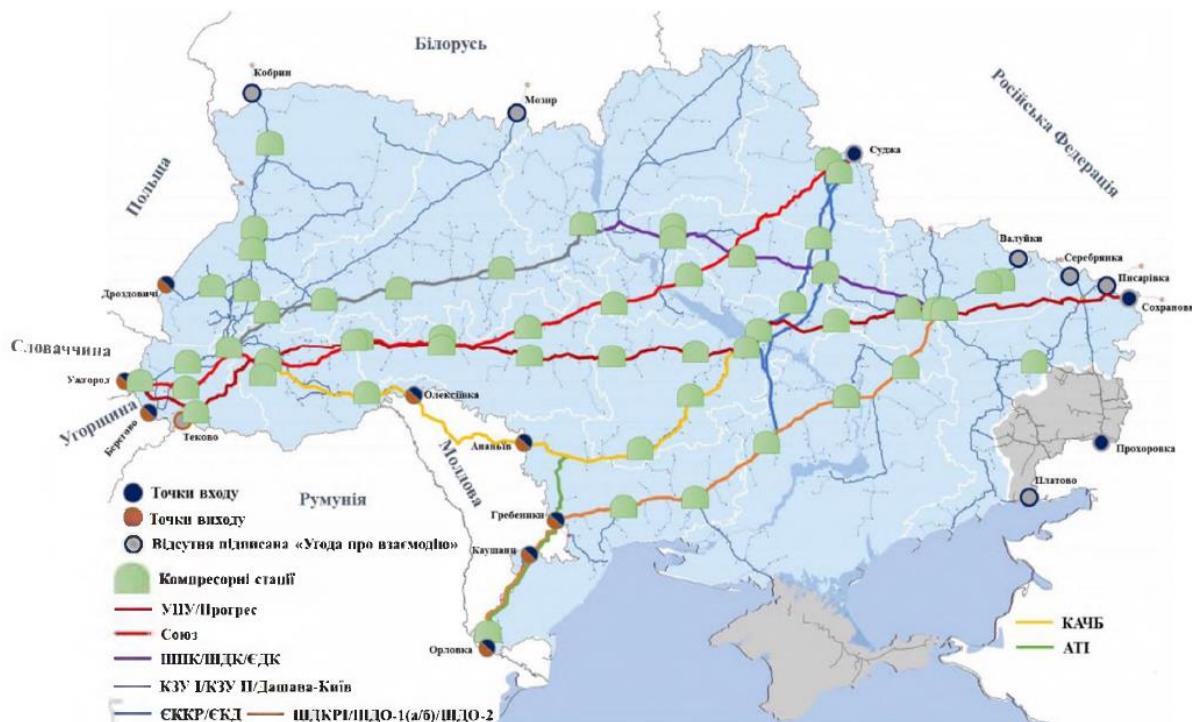
Analysis of the financing and implementation of overhaul, technical re-equipment and reconstruction of overhead transmission lines shows that the amount of restoration does not reduce the existing disproportion between aging and restoration and does not cover the actual wear and tear of overhead transmission lines. Today, this is one of the main problems in the operation of the TSO's overhead power lines. In general, the aging of structures and equipment occurs much faster than their replacement during reconstruction and overhaul.

Gas infrastructure

According to the ESU, 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



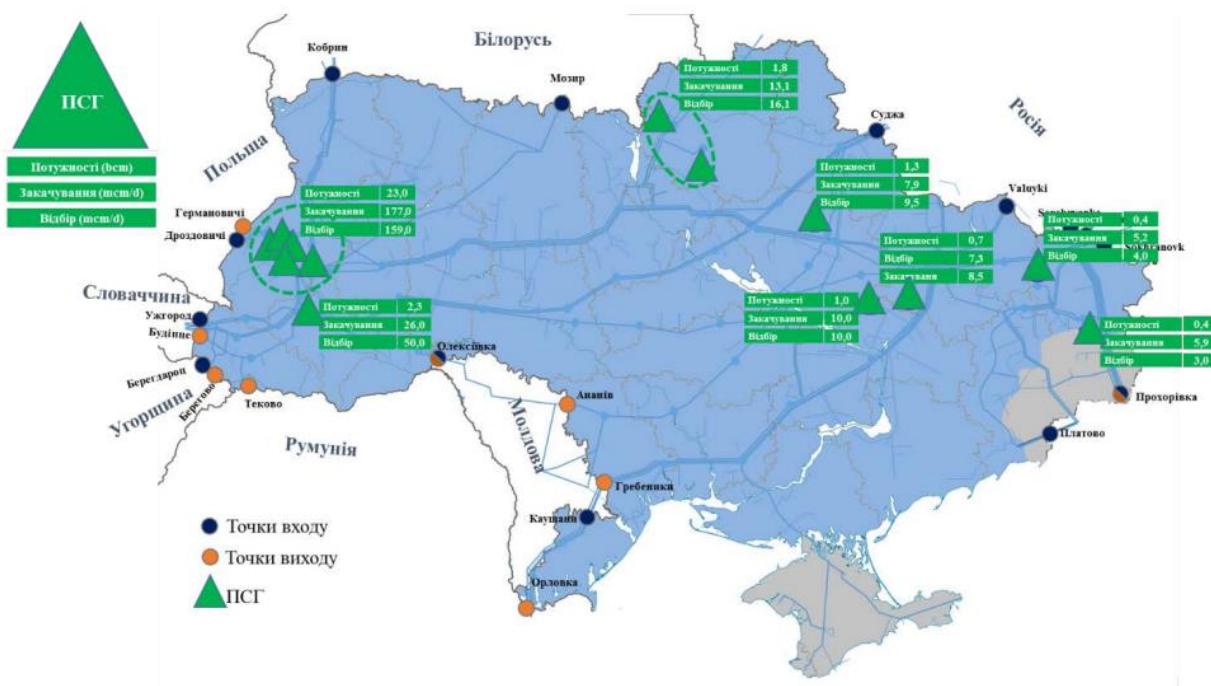
Source: GTS Operator of Ukraine LLC

At the same time, the capacity at the GTS inlet amounted to 281 billion cubic meters, and at the outlet - 146 billion cubic meters. On the European side, the GTS has interconnections with operators in Moldova,

Romania, Poland, Hungary, and Slovakia. In general, the capacity of interconnectors is sufficient to meet current needs, and given the cessation of gas transit from the Russian Federation, it may become excessive.

JSC Ukrtransgaz operates 12 underground natural gas storage facilities, two of which are based on aquifer structures and the rest on depleted gas fields, with a total active capacity of 30.95 billion m³ as of the beginning of 2022. Another 1 gas storage facility is located on the Crimean peninsula (operated by Chornomornaftogaz).

Main characteristics of Ukrtransgaz UGS facilities

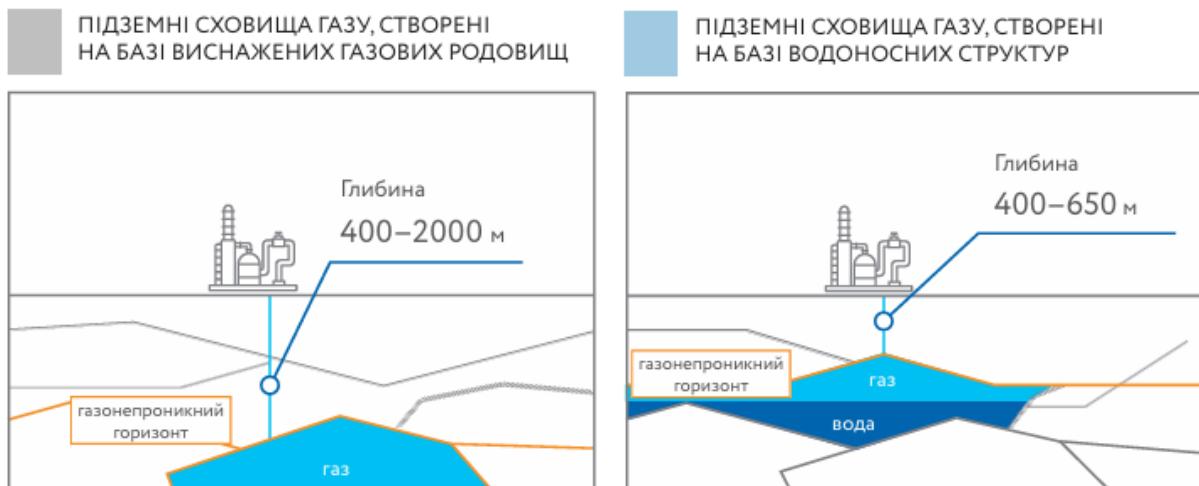


Source: Ukrtransgaz JSC³⁹³

³⁹³ Source: UGS development plan for 2021-2030.

The geological structure of the UGS facilities managed by Ukrtransgaz has the following characteristics:

Geological structure of Ukrtransgaz UGS facilities



Source: Ukrtransgaz JSC

ii. Projections of network expansion needs until at least 2040 (including 2030)

For both the electricity and gas infrastructure, the forecasts are based on the Transmission System Development Plan for 2024-2033 of NPC Ukrrenergo, the Gas Transmission System Development Plan for 2023-2032 of Gas Transmission System Operator of Ukraine LLC, and modeling results.

4.5.3. Electricity and gas markets, energy prices

i. Current state of electricity and gas markets, including energy prices

Electricity market

a) Characterization of the sector before and during the full-scale invasion of Ukraine by the Russian Federation

Prior to the full-scale invasion of the Russian Federation (February 24, 2022), Ukraine had excessive generating capacity. According to ENTSO-E, as of 01.01.2022, their nominal volume was about 54.8 GW³⁹⁴. The transmission system operator Ukrrenergo estimated the installed capacity at about 56.5 GW. The total generating capacity was more than 2.5 times higher than the maximum level of demand (electric load) observed in the winter period in the IPS of Ukraine during 2016-2022 - about 21-22 GW³⁹⁵. This excess capacity provided a significant production potential for electricity exports, in particular to the EU, which was mainly limited by the capacity of interstate crossings.

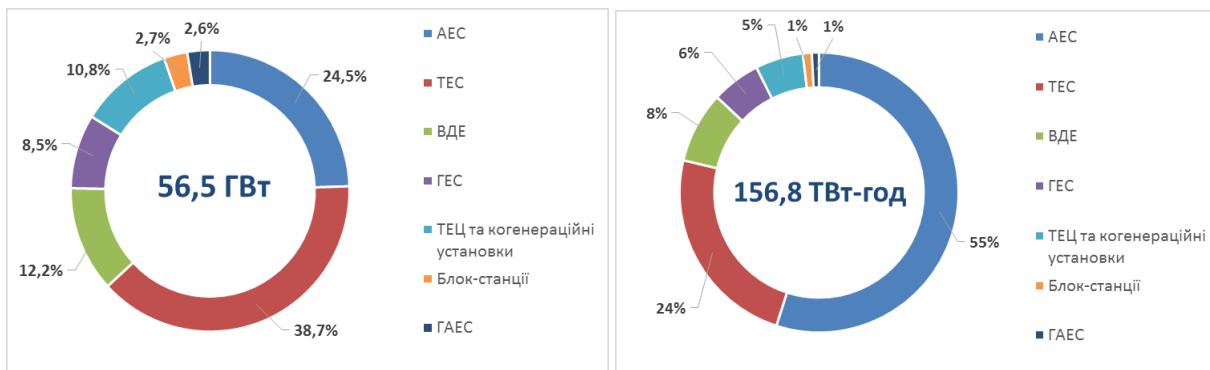
In 2021, the structure of installed capacities was dominated by coal-fired generation, but nuclear power has traditionally dominated electricity generation.

Installed capacity (2021)

Production structure (2021)

³⁹⁴ <http://bit.ly/3ZCPf9S> (ENTSO-E)

³⁹⁵ <https://www.iea.org/data-and-statistics/data-tools/ukraine-real-time-electricity-data-explorer>



The full-scale invasion of Ukraine by the Russian Federation had a significant impact on the electricity sector. On the one hand, Ukraine was able to prove the high level of resilience of its energy system by operating for three weeks in isolation and joining ENTSO-E, and in June, starting commercial electricity exports to the EU.

On the other hand, massive missile and drone attacks on energy infrastructure have caused significant destruction and damage to generation facilities and power grids. Most of the power plants are under occupation, including Zaporizhzhia NPP (6,000 MW), Luhansk, Zaporizhzhia and Vuhlehiria TPPs (about 7,700 MW). Kakhovka HPP (343 MW) was blown up and completely destroyed. On the territories uncontrolled by Ukraine 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 mines³⁹⁶. Due to the loss of a significant part of the power and transmission capacities in the power system, Ukraine suspended electricity exports to the EU countries from October 11, 2022, to April 2023.

Due to the large-scale migration of people abroad and the decline in production and business activity, the demand for electricity in the power system has decreased by about 30-35%. Nevertheless, in the context of the seizure and destruction of energy facilities, the volume of generation is insufficient to cover domestic demand.

Large-scale scheduled and emergency power outages have been introduced throughout Ukraine to stabilize the power system. In addition, to cover the domestic electricity shortage, the Government has begun work on creating special financial and economic mechanisms that, given the significant difference in electricity prices in Eastern Europe and Ukraine, will make imports from the EU economically viable.

б) Features of the structural organization and functioning of the electricity market

The Ukrainian electricity market, similar to European markets, consists of six main segments:

- the market for bilateral contracts (BTC),
- the day-ahead market (DAM),
- intraday market (IDM),
- the balancing market (BM),
- ancillary services market (ASM),
- retail market.

³⁹⁶

https://www.energycharter.org/fileadmin/DocumentsMedia/Occasional/2022_11_24_UA_sectoral_evaluation_and_damage_assessment_Version_IV.pdf

The operation of the markets is determined by the relevant rules approved by the Regulator. Most of the electricity is sold through the DAM - in 2022, the total sales amounted to about 135.5 million MWh³⁹⁷. About 18.2 million MWh were sold on the DAM (-49.1% compared to 2021), and 2.7 million MWh on the IDM (-46.7% compared to 2021).³⁹⁸.

The total volume of electricity purchased and sold on the DAM in 2023 increased by 14% to 20.8 million MWh, but did not reach the pre-war level. The intraday market sold 1.7 million MWh (-38.5% compared to 2022). The total cost of electricity purchased on the Market Operator's platform amounted to UAH 81.5 billion (excluding VAT). In 2023, 119 new companies became participants in the DAM and IDM. As of December 31, 2023, 573 agreements on participation in the DAM and IDM with energy companies trading on the Market Operator's platform were in force. The market concentration ratio (CR5) on the DAM demonstrated a high level among buyers - an average of 77%, among sellers - 74%.³⁹⁹

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 in the market, temporarily, until April 1, 2023, producers (except for RES producers) sell electricity under bilateral agreements exclusively at electronic auctions, the procedure for which is approved by the Cabinet of Ministers of Ukraine. In fact, trading on the DAM takes place through the electronic platform of the Ukrainian Energy Exchange (UEEX)⁴⁰⁰, as UEEX received the priority right to organize and conduct auctions based on the results of the competitive selection of organizers of electronic auctions for the sale of electricity under bilateral agreements⁴⁰¹.

At the same time, the DAM can be considered the leading pricing segment, whose quotes are mainly used to determine the prices for selling electricity on the DAM (usually at a discount of 5-10% from the DAM). It is worth noting that prices on the DAM and the IDM, as well as the balancing market, are regulated by price caps. The current price caps for DAM and IDM are as follows (as of November 30, 2023):

- maximum marginal 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;
- the minimum price ceiling is 10 UAH/MWh;⁴⁰²

on the balancing market (from April 10, 2024):

- maximum price cap from 00:00 to 07:00 and from 23:00 to 24:00 - 4,000 UAH/MWh; from 07:00 to 23:00 - 8,250 UAH/MWh;⁴⁰³
- the minimum price ceiling is 0.01 UAH/MWh.

Ceiling prices for electricity on the DAM and IDM by periods of the day (from November 30, 2023)

³⁹⁷ <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>

³⁹⁸ <https://www.oree.com.ua/index.php/web/10538>

³⁹⁹ <https://www.oree.com.ua/index.php/newsctr/n/22129>

⁴⁰⁰ <https://www.ueex.com.ua/auctions/electricenergy/>

⁴⁰¹ http://mpe.kmu.gov.ua/minugol/control/uk/publish/article?art_id=245396800&cat_id=35109

⁴⁰² <https://www.nerc.gov.ua/news/nkrekp-vstanovila-granichni-cini-na-elektrichnu-energiyu>

⁴⁰³ <https://www.nerc.gov.ua/acts/pro-vnesennya-zmini-do-postanovi-nkrekp-vid-09-listopada-2023-roku-2099>



According to the Market Operator JSC, which administers the DAM and the IDM, during the twenty-month period from March 2022 (the beginning of synchronized operation of the IPS of Ukraine and the ENTSO-E power systems) to October 2023, the price caps had a significant impact on the DAM, as in 36% of the billing periods, hourly DAM prices were at or close to (with a difference of less than 1%) the established upper limit of the price cap for the relevant billing period for this market segment⁴⁰⁴.

Comparison of price dynamics on the DAM of Ukraine and neighboring EU countries (Poland, Hungary, Slovakia and Romania) shows a low correlation, the main reason for which is insufficient capacity of interstate crossings, lack of integration of Ukrainian spot markets with EU markets and regulation of prices on the DAM of Ukraine by the Regulator through the application of price caps. During 2020-2023,⁴⁰⁵ the difference between the daily price indices of the DAM Base in the vast majority of periods (days) is higher than 2 EUR/MWh (in relation to Poland - in 98% of periods, Romania - 95.6%, Slovakia - 94.9%, Hungary - 95.8%). The average difference between the daily indices of the Base DAM of Ukraine relative to the markets of Poland amounted to 98.0 EUR/MWh, Romania - 269.8 EUR/MWh, Slovakia - 268.7 EUR/MWh, Hungary - 285.4 EUR/MWh⁴⁰⁶.

According to Market Operator JSC, as of the end of the first half of 2022, 523 market participants with active status were operating on the DAM and the VDR. Among them: 37 - electricity producers, 31 - distribution system operators (DSOs), 459 - suppliers, 27 - traders, 5 - large consumers, TSO (Ukrenergo) and a guaranteed buyer⁴⁰⁷. At the same time, as of the end of September 2023, the number of DAM and IDM participants with active status increased to 566 (+8.2%)⁴⁰⁸. The peculiarity of activities on the DAM and IDM during martial law is that suppliers and traders are prohibited from selling electricity on these

⁴⁰⁴ https://www.oree.com.ua/index.php/control/results_mo/DAM

⁴⁰⁵ The period during 2023 considered in the analysis of electricity prices on the DAM includes January-September 2023.

⁴⁰⁶ <https://map.ua-energy.org/uk/resources/5bee4464-ba9f-4117-a4ca-f71584bd5f54/>

⁴⁰⁷ <https://www.oree.com.ua/index.php/web/10431>

⁴⁰⁸ <https://www.oree.com.ua/index.php/main/register>

market segments. Thus, the main sellers are the generating companies and the guaranteed buyer that sells electricity generated from RES.

Trading on the DAM takes place in the form of auctions through the UEEEX platform⁴⁰⁹ or on the OTC segment. At the same time, state-owned generating companies are obliged to sell the entire volume of electricity sold under bilateral contracts through the UEEEX in accordance with the approved Procedure for holding auctions⁴¹⁰. Sales prices are not regulated and are determined by the results of auctions.

At the same time, it is worth noting that a significant amount of electricity is actually "taken out" of the competitive market, as it is sold under regulated procedures within the framework of the Public Service Obligation (PSO) mechanism defined by the Government⁴¹¹. Its main goal is to keep electricity prices for households low, which is one of the lowest in Europe.

c) Peculiarities of export implementation and regulation

Electricity exports from Ukraine are based on explicit⁴¹² auctions to allocate access to cross-border transmission capacity (CBTC) to potential exporters (producers, traders, suppliers)⁴¹³. The available TSO in the directions of Poland, Romania, Hungary, Slovakia and Moldova is determined by Ukrrenergo based on the technical capabilities of the cross-border crossings and in agreement with ENTSO-E⁴¹⁴. One of Ukrrenergo's activities is to provide market participants with access to the substations of the interstate power grids of Ukraine. The access is granted at joint coordinated auctions for the distribution of cross-border substations.

Since May 2017, an electronic platform for holding auctions for the allocation of interstate power grids has been implemented, which contains all information on the auctions. "Ukrrenergo, as a grid operator, holds annual, monthly and daily auctions for the allocation of access to export and import of electricity, where available TSOs are distributed on a competitive basis among the bidders. The export and import auctions are transparent, and their schedule and results are regularly published on the operator's online platform".⁴¹⁵

The companies participating in the auctions must conclude an agreement with Ukrrenergo on participation in the allocation of transmission capacity for the relevant year⁴¹⁶. As of January 12, 2023, the list of companies registered by Ukrrenergo for potential participation in the TSO auctions included 242 participants⁴¹⁷. However, there are significantly fewer active participants. For example, in July-September 2022, up to 12-13 companies (primarily traders and producers) participated in day-ahead auctions for electricity exports to Romania, Slovakia and Poland, ensuring intense competition and high prices for access to the TSO. Based on the results of the access distribution, companies purchased electricity on the wholesale market (primarily under bilateral contracts (on the DAM or DAM) and exported it on the basis of bilateral contracts with counterparties from the EU and Moldova.

⁴⁰⁹ <https://www.ueex.com.ua/auctions-calendar/elektrichna-energiya/>

⁴¹⁰ <https://zakon.rada.gov.ua/laws/show/499-2019-%D0%BF#Text>

⁴¹¹ <https://zakon.rada.gov.ua/laws/show/483-2019-%D0%BF#Text>

⁴¹² An explicit auction only provides for the allocation of access to cross-border capacity, but not the actual commercial volume of electricity that will be moved across the cross-border crossing under contracts or as a result of bidding.

⁴¹³ The capacity of interstate crossings of the IPS of Ukraine is the technical ability to ensure the supply of electricity through an interstate crossing in a certain direction, taking into account the maintenance and repair plans for the power equipment of the IPS of Ukraine and the power systems of neighboring countries.

⁴¹⁴ <https://eap-office.ua.energy/pages/bandwidth/public-ntc>

⁴¹⁵ <https://eap-office.ua.energy/pages/dashboard>

⁴¹⁶ https://ua.energy/wp-content/uploads/2022/12/Nakaz_616_-na-2023-rik.pdf

⁴¹⁷ <https://ua.energy/wp-content/uploads/2023/01/Reyestr-uchasnykiv-vid-12.01.23.xlsx>

Given the large price spread between the electricity markets of Ukraine and the EU 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 Electricity Market Participants Engaged in Electricity Export Operations to Ensure Public Interest in the Functioning of the Electricity Market During Martial Law"⁴¹⁸ (hereinafter - Resolution No. 775). By this Resolution, the Government introduced the PSO mechanism for export operations to "ensure security of supply and smooth functioning of the electricity market". According to this resolution, exporters are required to return 80% of their profits from electricity exports to the state-owned company Guaranteed Buyer. Moreover, the term of the export PSO is set to last until the day of termination or lifting of martial law in Ukraine.

According to Resolution No. 775, electricity exporters are obliged to: 1) enter into security agreements with the Guaranteed Buyer within five business days from the date of entry into force of this Regulation; 2) provide the Guaranteed Buyer with the information necessary to calculate the actual cost of the service for ensuring the security of electricity supply by 10 a.m. daily; 3) pay the Guaranteed Buyer the cost of the service for ensuring the security of electricity supply in accordance with the terms of security agreements in a timely manner and in full. In general, this legislative innovation has significantly limited the profitability of export operations and the commercial interest of exporting companies.

Also, the Law of Ukraine "On the Electricity Market" was amended to introduce a new scheme for the distribution of Ukrenergo's income from auctions for the allocation of interstate transmission facilities⁴¹⁹. Prior to the adoption of these amendments, all the revenue received by Ukrenergo at auctions for the allocation of access to the interstate TSOs was to be used exclusively for investing in the technical development of these networks. Taking into account the amendments to the Law, from August 1, 2022 to January 1, 2023, the transmission system operator (Ukrenergo) had to transfer 50% of the auction revenues to cover the debt accumulated in the balancing electricity market to the balancing service providers and other market participants responsible for balancing and 50% to the guaranteed buyer for further allocation of the relevant funds to NNEG Energoatom and RES electricity producers to cover the debt⁴²⁰. In addition, TPPs and CHPPs providing balancing services had to spend the funds received from Ukrenergo exclusively on the purchase of fuel (primarily thermal coal, natural gas or fuel oil) or maintenance of equipment to ensure the proper operation of generating facilities during the 2022-2023 heating season.

Starting from October 11, 2022, export auctions and commercial electricity exports were suspended due to a significant deficit in the Ukrainian power system as a result of targeted and systematic attacks by the Russian Federation on Ukraine's energy infrastructure (generating facilities and power grids). The TSO resumed holding auctions in 2023.

Natural gas market

Due to the full-scale invasion of Ukraine by the Russian Federation since February 2022, as well as the measures taken to counter its devastating effects, the development of the gas market and competition in it has slowed down significantly.

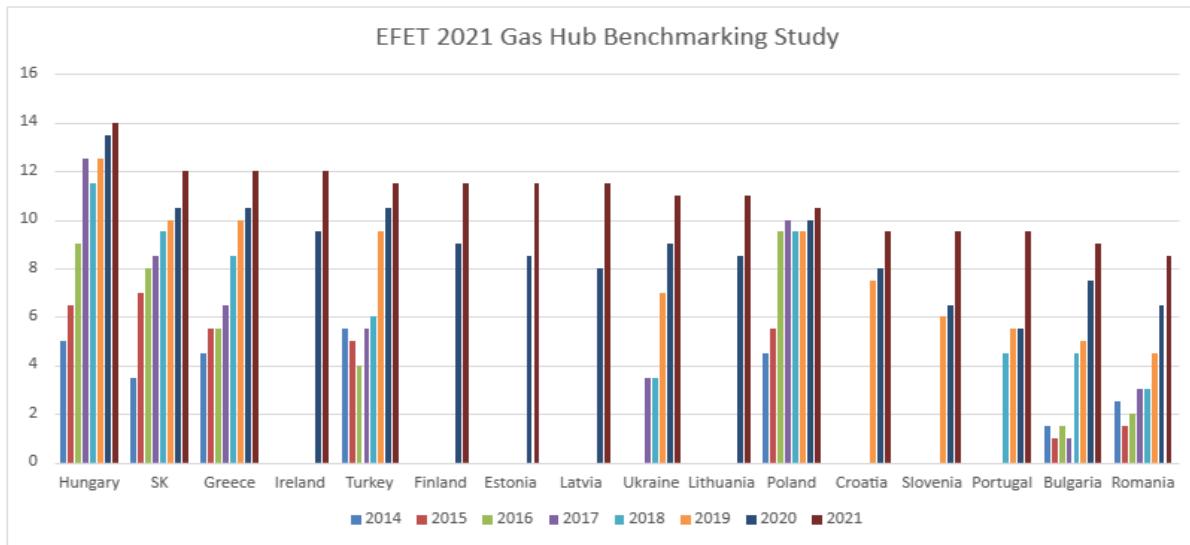
At the same time, in previous years, starting in 2014, Ukraine's gas market has developed significantly and become part of the European energy market. In particular, according to a comparison of European gas hubs conducted by EFET (European Federation of Energy Traders) in 2021,⁴²¹, the Ukrainian gas hub had fairly high development indicators and steady growth dynamics.

⁴¹⁸ <https://zakon.rada.gov.ua/laws/show/775-2022-%D0%BF#Text>

⁴¹⁹ <https://zakon.rada.gov.ua/laws/show/2479-IX#Text>

⁴²⁰ https://www.gpee.com.ua/news_item/1086

⁴²¹ <https://www.efet.org/home/documents?id=19>



Source: EFET

ACER had a similar assessment of the situation in the Ukrainian gas market. The 2020 wholesale gas market monitoring report states that in 2020, the volume of trading on the Ukrainian Energy Exchange increased to 2 billion m³ (from 0.3 billion m³ in 2019), and the number of trading participants doubled. Most of the trades were for products a month in advance, but day-ahead trades were also scheduled. Most of the liquidity was created by Naftogaz Group, which could increase trading volumes on this platform after reducing the scope of its special duties.⁴²²

Since February 2022, natural gas consumption, in particular by industry, has significantly decreased, and natural gas exports have been banned, creating negative incentives for private companies to develop production. In addition, a significant number of consumers receive gas at fixed prices.

In particular, a moratorium on price increases above the level in force as of February 24, 2022 is established by law, applies to household consumers, associations of co-owners of apartment buildings, housing cooperatives, other persons authorized by co-owners in accordance with the law who, by means of self-sufficiency, maintain autonomous heat supply systems of an apartment building owned by co-owners on the right of joint ownership in an apartment building, conclude contracts for the supply of natural gas for the operation of gas boilers (roof, attached and/or located on the property) in their interests.

In the case of household consumers, this price is UAH 7,960 per thousand cubic meters (including VAT). In the context of natural gas supply to household consumers, 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, approved by the CMU Resolution No. 222 of 06.03.2022 (hereinafter - PSO Regulation No. 222).⁴²³⁴²⁴ In the context of natural gas supply to heat energy producers, including condominium associations, housing construction (housing, service) cooperatives, and managers of apartment buildings, 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 regarding the peculiarities of natural gas supply to heat energy producers and budgetary institutions, approved by the Resolution of the Cabinet of Ministers of Ukraine No.

Table of prices in accordance with the PSO Regulations (as of February 2024)

⁴²² ACER Market Monitoring Report 2020 - Gas Wholesale Market Volume, 14/7/2021.

⁴²³ <https://zakon.rada.gov.ua/laws/show/222-2022-%D0%BF%n31>

⁴²⁴ <https://zakon.rada.gov.ua/laws/show/812-2022-%D0%BF%n34>

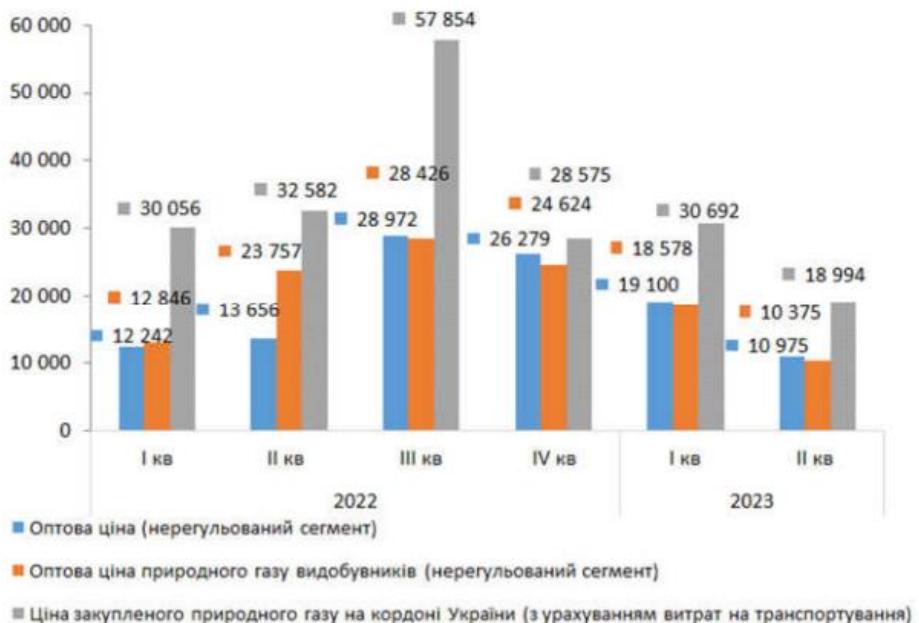
Consumer category	Price, UAH/m3 including VAT	Legal basis	Calculation formula (if any)	Validity period
Household consumers (Naftogaz)	7.96	Law on the moratorium	fixed price (the supplier's base offer, effective as of 02/24/2022)	6 months after the termination of martial law
Gas suppliers for household consumers	7.24	Provisions of the PSO No. 222	basic annual offer of the supplier, net of trade margin (markup) 0.6 UAH/m3	15.04.2024
TKE for categories:				
population (within the fixed volume I), including budgetary institutions - heat producers for the population	7.42	Provisions of the PSO No. 222	fixed price (in the PSO Regulation)	15.04.2024
budgetary institutions, religious organizations, and enterprises of the State Administration of Ukraine (within the fixed scope of Volume III)	16.39		fixed price (in the PSO Regulation)	
other consumers (within the floating volume II)	16.49		a formula based on the weighted average price for the resource of the month preceding the month of natural gas supply, based on the results of electronic exchange trading on the Ukrainian Energy Exchange	
Dormitories	7.42	Provisions of the PSO No. 812	fixed price (in the PSO Regulation)	15.04.2024
Budgetary institutions and religious organizations	16.39	Provisions of the PSO No. 812	fixed price (in the PSO Regulation)	15.04.2024
Electricity producers:				

CHP (condensing)	10.95	Provisions of the PSO No. 222	fixed price (in the PSO Regulation)	15.04.2024
CHP (thermal power plant)	16.5		fixed price (in the PSO Regulation)	
Gas turbine and gas piston plants	16.5		fixed price (in the PSO Regulation)	
Operators of the gas distribution system:				
Normalized Gross Domestic Product (Volume I)	7.42	Provisions of the PSO No. 222	fixed price (in the PSO Regulation)	within 6 months after the termination of martial law
Excessive military time off (except for "war losses") (Volume II)	18.8		a formula based on the price of gas on the Slovak market, including delivery to Ukraine	
"Losses of war" ("Losses caused by military operations and incurred in connection with the prevention/resolution of humanitarian crisis situations") (Volume III)	0.01		fixed price (in the PSO Regulation)	

Given this perimeter of PSO provisions and other factors, only small volumes are traded on the open market, as evidenced by information from existing trading platforms such as the Ukrainian Energy Exchange. According to the SEEGAS initiative, in 2022, the volume traded on this main gas exchange amounted to 167.45 million m³⁴²⁵. According to the NEURC, there is a significant difference between gas prices at the border (including transportation costs) and gas prices sold on the domestic market by producers⁴²⁶.

⁴²⁵ <https://www.energy-community.org/regionalinitiatives/SEEGAS.html#pouqvh-accordion>

⁴²⁶ https://www.nerc.gov.ua/storage/app/sites/1/Docs/Sfery_Gaz/Monitoring_rynku_gaz/2023/monitoring_gaz_II-2023_.pdf



Source: NEURC

In total, according to the NEURC, 180 and 168 suppliers (respectively) were engaged in natural gas supply in the first and second quarters of 2023, of which 13 companies also supplied natural gas to household consumers. In both quarters, 97% of natural gas supplies to households were carried out by Gas Supply Company Naftogaz of Ukraine LLC.

In terms of protecting vulnerable consumers and combating energy poverty, according to the National Economic Strategy until 2030, a significant portion of the household budget is spent on utilities. In 2019, utility costs accounted for more than 13% of total household expenditures, which is one of the significant components of the household budget. According to various sources, the average level of energy poverty in Ukraine ranges from 11% (according to the State Statistics Service of Ukraine) to 13-18% (according to the Energy Community). According to the 2021 Household Self-Assessment of Affordability of Selected Goods and Services, 15.4% of households did not have enough money to pay their housing bills and necessary maintenance services on time and in full, or to pay for gas for cooking, and 17.2% did not have enough money to keep their homes warm enough during the heating season.

Energy use in transportation

Energy use in transport requires a separate review (separate from the review of electricity and natural gas markets), given the diversity of transport modes and the 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 oil products) and charging infrastructure for electric vehicles.

EU statistics⁴²⁷ defines the division of transport modes into freight and passenger. Within freight transport, there are:

- land transport (road transport, rail transport, pipeline transport);

⁴²⁷ Eurostat, Key figures on European transport, 2022 edition, [Key figures on European transport - 2022 edition \(europa.eu\)](https://ec.europa.eu/eurostat/statistics-explained/index.php/Key_figures_on_European_transport_-_2022_edition_(europa.eu))

- water transport (sea transport, inland water transport);
- air transportation.

Within passenger transportation, there are distinguished:

- land transport (road transport, rail transport); road passenger transport is carried out by passenger cars, motorcycles and mopeds, as well as buses;
- water transport (sea transport, inland water transport);
- air transportation.

Since the beginning of 2022, due to the full-scale invasion of Ukraine by the Russian Federation, sea, inland waterway and air transport has significantly decreased in Ukraine.

JSC "Ukrzaliznytsia" is a unified operator of railway transportation. The main types of energy products used by JSC "Ukrzaliznytsia" for train traction are diesel fuel and electricity.⁴²⁸

In Ukraine, the following types of energy products are used for road transport:

- Gasoline;
- Diesel fuel (DF);
- Liquefied petroleum gas (LPG);
- Compressed natural gas (CNG);
- Electricity.

Liquefied natural gas (LNG) is not currently used for transportation purposes.

Part of the gasoline, diesel fuel, and autogas (LPG, CNG) is produced in Ukraine; however, most of the required volumes are imported. According to Naftorynok, in 2023, the number of importers of diesel fuel amounted to 652, compared to 657 in 2022. In 2023, 24% more diesel fuel was imported than in 2022, and the main importers were OKKO, WOG and UPG, which together accounted for almost 30% of the volume of imported diesel fuel⁴²⁹. At the same time, since February 24, 2022, the number of licenses issued (at the applicant's location) for the wholesale trade in fuel in the absence of sales outlets has increased by 589 units compared to 2019-2021 - the beginning of 2022, to 1862⁴³⁰. In addition, from February 2022 to November 2023, 104 new gas stations started operating in Ukraine: 45 in 2022 and 59 in 2023⁴³¹.

According to the Automotive Market Research Institute, prices for petroleum products at Ukrainian gas stations in 2023 were as follows:

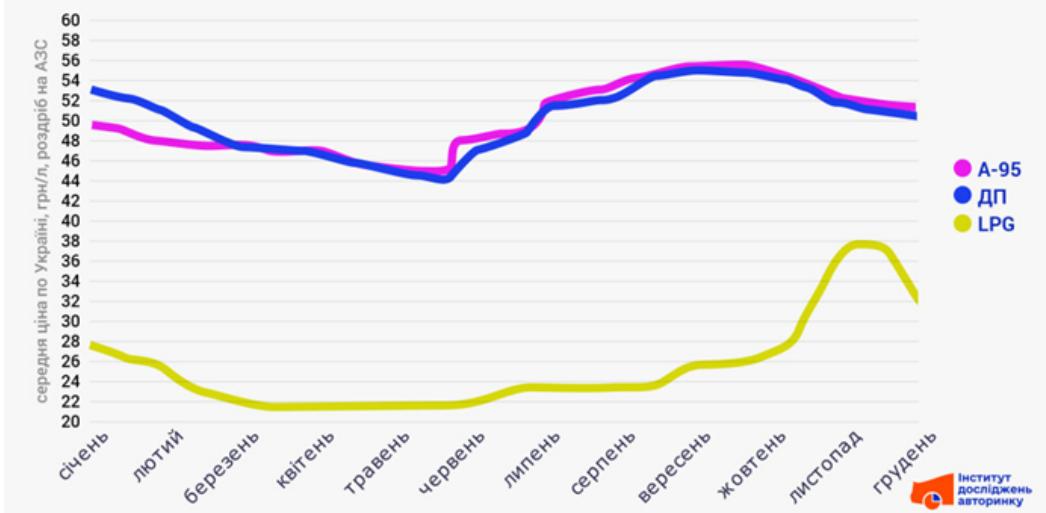
⁴²⁸ https://www.uz.gov.ua/press_center/up_to_date_topic/page-3/618680/

⁴²⁹ <https://www.nefterynok.info/novosti/upg-okko-ta-wog-importuvali-tretinu-dizpalnogo-u-2023-rr>

⁴³⁰ <https://www.nefterynok.info/novosti/klkst-vidanii-optovih-lcency-zrosla-na-46-u-2022-2023-rr>

⁴³¹ <https://www.nefterynok.info/novosti/z-pochatku-povnomasshtabnogo-vtorgnennya-zapracyuvali-104-novih-azs>

Ціни на основні види пального на АЗС, в Україні у 2023 році



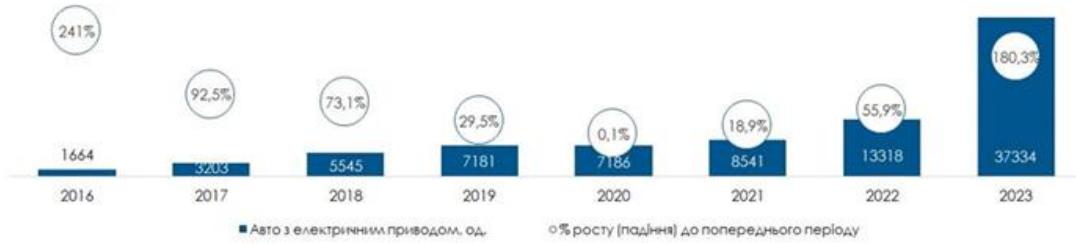
As of September 2023, the total fleet of electric vehicles registered in Ukraine is 72435 units: 70316 cars, 2114 trucks and 5 buses⁴³². The number of public charging stations for electric vehicles is approximately 3.2 thousand⁴³³.

The dynamics of increasing the number of electric vehicles

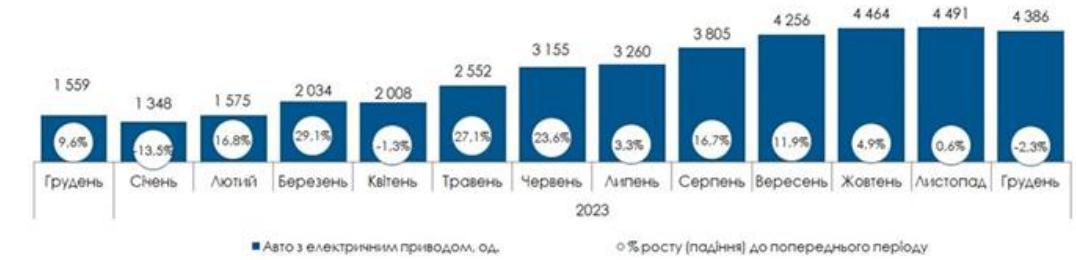
⁴³² <https://eauto.org.ua/news/393-rekordna-kilkist-vzhivanih-elektromobiliv-z-za-kordonu-ta-import-novih-z-kitayushcho-kupuvali-u-veresni>

⁴³³ <https://eauto.org.ua/news/375-ukrainoyu-jizdit-na-20-tisyach-bilshe-elektromobiliv-nizh-u-polshchi>

ЩОРІЧНА ДИНАМІКА РЕЄСТРАЦІЙ АВТО З ЕЛЕКТРИЧНИМ ПРИВОДОМ
(шт. та % росту до попереднього періоду)



ЩОМІСЯЧНА ДИНАМІКА РЕЄСТРАЦІЙ АВТО З ЕЛЕКТРИЧНИМ ПРИВОДОМ
(шт. та % росту до попереднього періоду)



МАТЕРІАЛ ПІДГОТОВЛЕНО АНАЛІТИЧНИМ ЦЕНТРОМ ФЕДЕРАЦІЇ АВТОПРОМУ УКРАЇНИ



ii. Development projections based on existing policies and measures until at least 2040 (including 2030)

Electricity market

The key factors that will determine the situation on Ukraine's electricity market and the potential for foreign trade after the lifting or termination of martial law include the following:

- 1) the extent of damage and destruction of generation facilities and grids, which will determine the level, structure, and flexibility of electricity supply, as well as the level of prices in the domestic market;
- 2) the degree of price caps and other types of regulation in the wholesale market segments;
- 3) a policy to bring electricity prices for households to market-based levels, along with a gradual minimization of PSO and an increase in the supply of electricity in a competitive market;
- 4) deepening integration with the EU markets (increasing cross-border capacity and integration format), in particular by combining day-ahead and intraday markets (market coupling) with Eastern European countries (Poland, Romania, Slovakia, Hungary, and Moldova).

Taking into account the factors of significant inflation, we can expect a gradual increase in the level of marginal prices (price caps) for electricity in the wholesale market segments (DAM, IDM and balancing market). The revision of price caps will lead to a corresponding increase in wholesale electricity prices, including in the DAM segment, which is guided by the DAM reference price quotations.

Prices for households will remain at the current level until the end of the 2023/2024 heating season. Their upward revision during the martial law in Ukraine is possible, subject to a small multi-stage increase spread over time (at least for 2-3 years). The Cabinet of Ministers of Ukraine will adopt a Roadmap for the gradual liberalization of the gas and electricity markets with steps to be taken and corresponding deadlines to be

implemented after the end of martial law. The Roadmap will be based on a technical analysis to understand the financial state of the sector.

As part of the deepening of European market integration, JSC Market Operator joined the Committee of European Market Operators (NEMO Committee) as an observer of the operation of the EU's unified spot electricity market - SDAC (single day-ahead coupling) and SIDC (Single Intraday Coupling). The observer status allows to start technical preparations for the unification of the spot markets of Ukraine and European countries⁴³⁴. To unify spot markets, a number of tax issues related to foreign trade in electricity need to be regulated at the legislative level, including the payment of value added tax, excise duty, and import duty. Ukraine's full participation in the unified spot market of Eastern European countries will expand opportunities for the development of 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 depending on the ratio of conditions on the unified spot electricity markets.

Natural gas market

The existing policies and measures generally do not allow achieving all the goals set for the Domestic Energy Market - Gas dimension.

First, export restrictions for both natural gas and biomethane severely limit domestic production and distort domestic prices. In the context of biomethane, this ban reduces the pressure on the sector to overcome other problems faced by biomethane producers (e.g., problems with access to the grid): in the case of exports, these problems have become more urgent and their solution has been accelerated.

Secondly, the existence of price restrictions (under the PSO provisions) on a large number of consumers also discourages production, including through the development of new technologies and the search for synergies. In addition, such restrictions - against the backdrop of reduced consumption due to the hostilities - lead to weaker competition due to a decrease in imports and importers who usually compete with sellers of domestically produced gas.

Third, without additional measures, the conditions for operating in the domestic gas market are complicated and burdensome for new players. This includes uncertainty about the fate of property and assets of the GDS operators, insufficient separation of their interests from supply and production, and lack of guarantees of adequate financing, which has a significant impact on the retail market. Related to this are the problems of balancing rules and the lack of a comprehensive system of commercial gas metering (against the background of insufficient metering equipment for consumers), which, under existing policies and measures, do not allow suppliers to independently manage their gas supply risks, especially for household consumers. At the same time, the quality of the market should be reflected in an increase in competitive offers, which can be obtained by household consumers.

Existing policies and measures in the infrastructure sub-dimension are generally adequate to ensure sufficient interconnection of the Ukrainian and EU gas networks (in terms of planning and market demand identification, and new product development). At the same time, they are not sufficient to properly adapt these networks to the requirements of the future energy market (in terms of optimization, integrated planning, conversion to new substances, balancing the interests of infrastructure operators and different gas producers, etc.)

In addition, the existing policies and measures create positive incentives for the development of natural gas production, but, according to market participants, may not be sufficient to achieve the planned production volumes, let alone obtain additional volumes of gas for export.

⁴³⁴ <https://www.oree.com.ua/index.php/newsctr/n/17286>

4.6. Dimension "Research, Innovation and Competitiveness"

i. The current situation of the low-carbon technology sector and, to the extent possible, its position on the global market (relevant analysis should be carried out at Union or global level)

International innovation rankings are one of the qualitative sources of information on the level of innovation in a country. This applies, in particular, to innovations in the field of energy and climate technologies.

European Innovation Scorecard

According to the European Innovation Scorecard (EIS) 2023⁴³⁵, Ukraine belongs to the Emerging Innovators group along with Bulgaria, Croatia, Latvia, Poland, Romania, Slovakia, and Poland, and demonstrates a performance indicator in innovation areas of 31% of the EU average. The EIS identifies the export of intellectual services, environmentally friendly technologies, employment in service industries, venture capital investments, and innovations without a significant R&D component as relatively strong points of the Ukrainian economy. On the other hand, the EIS identifies product innovation, design, sales of innovative products, involvement in international scientific publications, and R&D spending in publicly funded sectors as relatively weak.

Global Innovation Index

According to the Global Innovation Index 2023⁴³⁶, which is compiled annually by the World Intellectual Property Organization (WIPO), Ukraine ranked 55th among all analyzed countries and was among the three most innovative countries in the lower-middle-income group, along with India and Vietnam. According to the authors of the Global Innovation Index, in Ukraine, the results of innovation sectors exceed the amount of investment in them (Output rank - 47 / Input rank - 78), which places Ukraine in the "innovation outperformer" group.

Clean Energy Demonstration Projects Database (IEA)

Some relevant international rankings and databases do not contain data on Ukraine or innovative energy and climate projects implemented in Ukraine. For example, one of the most well-known databases of innovative energy projects, the International Energy Agency's Clean Energy Demonstration Database, does not contain any references to clean energy demonstration projects in Ukraine. At the same time, this database contains information on demonstration projects implemented in countries that are on 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 particular database may be due to the fact that our country became an associate member of the IEA quite recently (in 2021), as well as the fact that clean energy demonstration projects in Ukraine are funded and implemented mostly by private companies without government involvement.

Financing research and innovation under international agreements

Much of the research and innovation activity in Ukraine in areas related to the National Energy and Climate Plan is carried out under the 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

⁴³⁵ "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.

⁴³⁶ "Global Innovation Index 2023: Innovation in the face of uncertainty - WIPO." https://www.wipo.int/global_innovation_index/en/2023/.

European Union⁴³⁷, which is extended until 2022. Under the Agreement, Ukraine became a member of the Horizon Europe initiative and the Euratom Research and Training Program. Ukrainian players in the research and innovation sector can participate in them on equal terms with representatives of EU member states.

The Horizon Europe initiative has a total research grant budget of €95.5 billion for 2021-2027. A significant part of the funding through Horizon Europe is aimed at research in the field of climate and energy solutions, in particular:

1. **Horizon Europe Cluster 5:** Climate, Energy and Mobility: This cluster is dedicated to combating climate change, developing sustainable energy solutions and promoting mobility, covering a variety of programs and funding opportunities for sectors such as clean energy, renewable energy, energy efficiency, climate adaptation and others.
2. **European Green Deal Call:** As part of Horizon Europe, the European Green Deal Call is a funding program for projects that contribute to the European Green Deal's goal of climate neutrality by 2050.
3. **Mission Area on Climate-Neutral and Smart Cities:** Horizon Europe also includes specific areas of activity aimed at addressing societal challenges, including the goals of climate neutrality and smart cities. The objective of this area is to support research and innovation projects that contribute to the sustainable development of European cities.

In October 2023, the Horizon Europe Office in Ukraine was launched in Ukraine on the basis of the National Research Foundation of Ukraine⁴³⁸.

Also, under the aforementioned agreement, Ukraine gained access to research and innovation programs covering energy and climate:

- EIC4Ukraine⁴³⁹ is 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 €5 million program to support partnerships with Ukrainian cities to support their efforts to rebuild in a climate-neutral way
- Technologies for extraction and processing of critical raw materials (IA) is an initiative to support the building of sustainable supply chains for critical materials to strengthen the EU's partnership with countries rich in relevant minerals to ensure the security of industrial sectors and the environmentally friendly transformation of extractive industries in partner countries.
- Excellence Hubs Initiative⁴⁴⁰ - a "mentoring" program for the development of innovative components, to which Ukrainian participants are invited.

The Horizon Europe program has already implemented several research projects in the energy sector:

- BIOMETHAVERSE⁴⁴¹: 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 developing

⁴³⁷ 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

⁴³⁸ The Horizon Europe Program Office in Ukraine has started its work on the basis of the NISS <https://nrfu.org.ua/news/rozpochav-svoju-robotu-ofis-programy-goryzont-yevropa-v-ukrayini-na-bazi-nfdu/>

⁴³⁹ https://ec.europa.eu/commission/presscorner/detail/en/IP_22_3533

⁴⁴⁰ https://rea.ec.europa.eu/funding-and-grants/horizon-europe-widening-participation-and-spreading-excellence/excellence-hubs_en

⁴⁴¹ <https://cordis.europa.eu/project/id/101084200>

biomethane and green hydrogen production technologies in Europe in line with the Strategic Energy Technology Development Plan (SET plan).

- The TWISMA project⁴⁴² aims to increase the level of scientific development and innovation capacity of the Institute of Scintillation Materials (Kharkiv) and its partner institutions within the framework of Twinning programs 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 of high- and medium-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. At the same time, according to the State Statistics Service, in Ukraine, this share was 25.7% in 2016 (7.6% and 18.1% in the high- and medium-tech sectors, respectively). If we compare the gross domestic product per capita in 2016 in current prices of 2010 of the above-mentioned countries with the GDP per capita of Ukraine, according to the US National Science Foundation, 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 among 142 countries surveyed⁴⁴³.

According to the Innovation Development Index presented by Bloomberg in 2020, Ukraine ranked 56th out of 60 countries surveyed⁴⁴⁴.

⁴⁴² <https://cordis.europa.eu/project/id/101078960>

⁴⁴³ "Global Competitiveness Report 2020 | World Economic Forum." 16 Dec. 2020,

<https://www.weforum.org/publications/the-global-competitiveness-report-2020/competitiveness-rankings/>.

⁴⁴⁴ <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

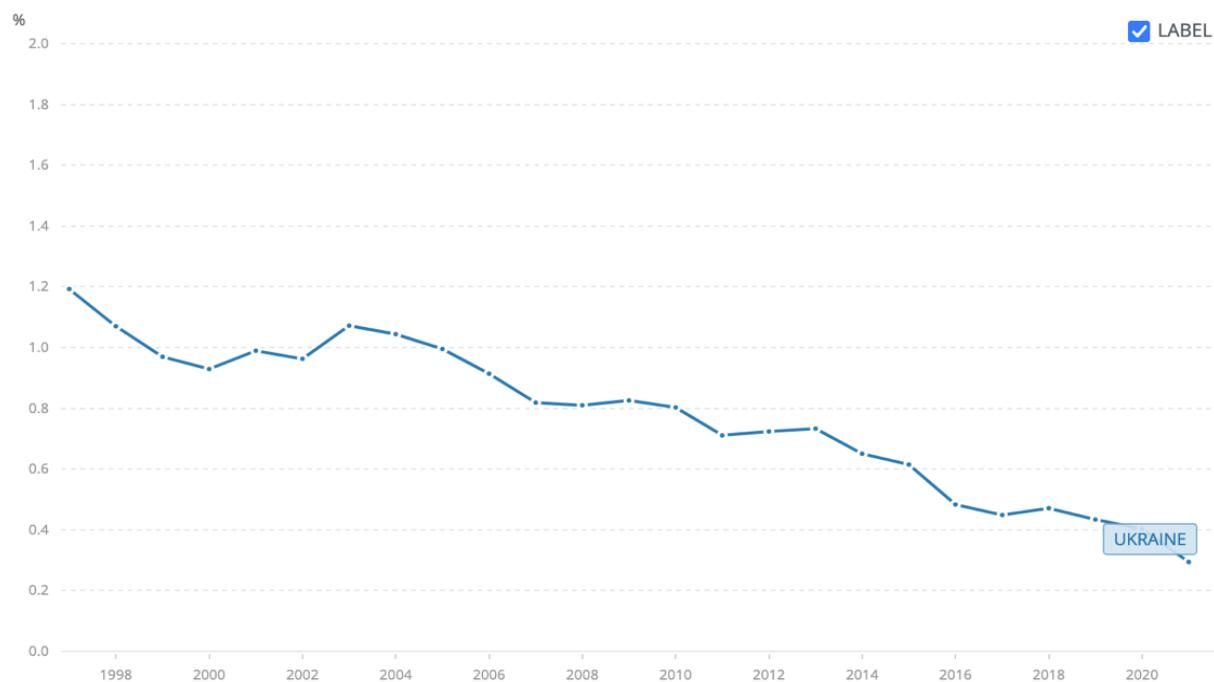
All metrics are equally weighted. Metrics consisting of multiple factors were rescaled for countries void of some but not all data points. Most recent data available used. Of the more than 200 economies evaluated, 105 had data available for at least six of the seven factors and were ranked; The top 60 and the metric ranks among them are displayed.

Bloomberg

ii. Current level of public and, if available, private expenditures on research and innovation in the low-carbon technology sector, current number of patents and current number of researchers

Ukraine demonstrates rather low rates of spending on research and innovation compared to other Eastern European countries. Thus, according to the World Bank⁴⁴⁵, as of 2021, R&D expenditures in Ukraine amounted to only 0.29% of GDP.

Ukraine's R&D expenditures as a percentage of GDP



Spending on research in the low-carbon technology and innovation sector in Ukraine is carried out by both public and private entities.

Government institutions finance research and innovation development mainly through specialized research institutions and grant funding from the National Research Foundation. Key research institutions include:

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 Beet (National Academy of Agrarian Sciences)
- Institute of Electrodynamics of the National Academy of Sciences of Ukraine

⁴⁴⁵

<https://data.worldbank.org/indicator/GB.XPD.RSDV.GD.ZS?contextual=region&end=2021&locations=UA&start=1997&view=chart>

- Department of Hydrogen Energy of the Pidgorny Institute of Mechanical Engineering 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
 - Ivano-Frankivsk National Technical University of Oil and Gas
2. Private
- Scientific and Technical Center "Biomass" LLC (approximately 15 researchers)
 - MHP Eco Energy (approximately 20 researchers)
3. Individual university departments
- Educational and Research Institute of Energy, Automation and Energy Saving (NUBIP)
 - Department of renewable energy sources of NTU KPI
 - The direction of renewable energy engineering at IFNTUOG

It is worth mentioning that there is a bachelor's degree program in Renewable Energy and Hydropower in the field of Electrical Engineering⁴⁴⁶. This specialty is taught in the following universities⁴⁴⁷:

- NUWGP (Rivne)
- Vinnytsia National Technical University
- NTU "KHPI"
- KNUBA
- Lviv National University of Environmental Management
- ZNU (Zaporizhzhia)

Estimating the specific amount of **private company** investment in low-carbon research and innovation in Ukraine is difficult due to the non-public nature of a large number of investments made by private companies. The latter can be divided into several groups with different business models and sources of capital.

Startups

These players in the low-carbon innovation market in Ukraine are focused on 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
- Equity (bootstrapping)

⁴⁴⁶ <https://osvita.ua/consultations/spec-bach/64447/>

⁴⁴⁷ <https://osvita.ua/consultations/vartist-navchannya/90604/>

- Grant funding

A clear assessment of investments in low-carbon technologies by Ukrainian startups is challenging due to the non-public nature 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 commercialization than those developed by startups, or are already commercially available globally but are still very new to the Ukrainian market. The largest corporate innovators in Ukraine include:

- DTEK invests in energy storage, smart grids, and electromobility technologies, has its own research centers and an innovation program. DTEK was the first company to implement a 1 MW energy storage system at the currently occupied Zaporizhzhya TPP;
- MHP invests in biomass processing technologies, hydrogen technologies, energy storage, and electric mobility, and 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 the commercial use of energy storage systems;
- RGC (now the main assets are managed by Naftogaz Group) - conducted a study of the possibility of transporting renewable gases (hydrogen and biomethane) through the distribution network built for natural gas;
- GALS Agro and VitAgro invest in biomass-to-renewable gas (biomethane) technologies and are interested in Biomethane2grid projects;
- Aventston
- Atmosfera

It is worth noting that a significant number of Ukrainian companies have started investing in low-carbon technologies, primarily energy technologies. The drivers of such investments are the factors listed below:

- Businesses need to ensure their energy security and cut costs. After the shelling of energy infrastructure by Russian troops, many businesses faced an acute problem of energy supply. As a result, Ukrainian entrepreneurs began installing off-meter electricity generation and storage facilities;
- Exporters' attempts to minimize the financial impact of CBAM implementation on them. Ukrainian companies exporting their goods to EU countries are calculating the financial impact of CBAM implementation and investing in low-carbon production chains.

Number of patents in green economy sub-sectors in Ukraine⁴⁴⁸

	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
<i>Надпровідникові електричні елементи</i>	Y02E40/60-69	0
<i>Геотермальна енергетика</i>	Y02E10/10-18	0

iii. Breakdown of current prices for the elements that make up the three main components of the price (energy cost, network costs, taxes/fees)

The cost of electricity for Ukrainian consumers is formed according to the categories to which certain consumers belong. Electricity tariffs for individuals through the PSO mechanism (implemented through state-owned enterprises) are subsidized by higher tariffs for consumers belonging to legal entities.

Key components of tariffs for Ukrainian consumers:

- The cost of electricity on the centralized electricity market (floating)
- Tariff for electricity transmission through Ukrenergo's high-voltage networks (set at UAH 0.582 per kWh);
- Tariff for electricity distribution by low-voltage networks of DSOs (approved by the NEURC at UAH 1.753 per kWh);
- Tariff for the supplier's services (contractual for legal entities, fixed for household consumers);
- Taxes (VAT, excise).

iv. Description of energy subsidies, including for fossil fuels

⁴⁴⁸ D. in Economics, Professor, Corresponding Member of the National Academy of Sciences of Ukraine V. Y. Hryha, Candidate of Economic Sciences, S. S. Ryzhkova, Research Scientist "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.

In Ukraine, there are several types of direct and indirect subsidies in the state-regulated energy markets (gas, electricity, district heating). The system of energy subsidies in Ukraine is primarily aimed at protecting vulnerable households that can be characterized as energy poor. However, the largest beneficiaries of this system are wealthy citizens. This is the result of the fact that the energy subsidy system in these markets consists of several levels:

1. Different tariffs for households and legal entities. In the gas, district heating, and electricity markets, there are preferential prices/tariffs for households (household consumers) and market prices/tariffs for legal entities. There are also separate preferential prices/tariffs for religious organizations;
2. Targeted subsidies for vulnerable consumers provide financial assistance to households whose utility costs exceed a percentage of their monthly income set by the government.

Typical mechanisms that allow setting prices/tariffs for household consumers (households) at a level below the economically justified level are as follows:

- Cross-subsidization at the expense of non-household consumers' tariffs as part of the mechanism of assigning special obligations (PSO) to individual market participants to ensure the public interest, for example, in the electricity market;
- Reimbursement through additional financing of state-owned companies involved in PSO from the state budget (for example, in the gas market);
- Support for heat producers from local budgets.

Terminology notes

It is worth noting that there are several interpretations of subsidies in the Ukrainian legal framework. A number of different terms are used in the legislation on budget policy and state support. These terms can be compared to components of broader definitions used by international organizations. A direct and rather narrow definition of subsidies is provided in the Instruction on the application of the economic classification of budget expenditures⁴⁴⁹, approved by the Order of the Ministry of Finance of Ukraine No. 333 of March 12, 2012. According to the Instruction, subsidies are defined as "all non-repayable current payments to enterprises that do not provide for compensation in the form of specially stipulated payments or goods and services in exchange for payments made, as well as expenses related to compensation for losses of state-owned enterprises".

The Ukrainian budget legislation contains a number of subventions, grants and other transfers that are not considered subsidies under the national legislation but are in fact subsidies under international definitions. In addition, the term "subsidy" does not apply to tax privileges, but the Government of Ukraine considers some cases of tax privileges as revenue foregone and the Ministry of Finance estimates 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" in the Agreement on Subsidies and Countervailing Measures (SCM Agreement)⁴⁵⁰ is automatically applied to state regulation in Ukraine.

1.1 For the purposes of this Agreement, a subsidy shall be deemed to be:

⁴⁴⁹ Instruction on the application of the economic classification of budget expenditures

<https://zakon.rada.gov.ua/go/z0456-12>

⁴⁵⁰ Agreement on Subsidies and Countervailing Measures https://zakon.rada.gov.ua/go/981_015.

- a) 1) a financial contribution provided in the territory of a WTO Member by the government or any government agency (referred to in this Agreement as the government), i.e., when*
- i) the government practices direct transfers of cash (e.g., grants, loans, or capital injections), potential direct transfers of cash or liabilities (e.g., loan guarantees);*
 - ii) the government waives or does not collect revenues that are due to it (e.g., fiscal incentives such as tax credits)[1];*
 - iii) the government provides goods and services other than general infrastructure or procures goods or services;*
 - (iv) the government makes payments to the financing mechanism or entrusts or directs a private entity to perform one or more of the functions described in (i) and (iii) above that would normally be performed by the government, and the practice of the entity is not materially different from the practice that the government would normally conduct;*
- or*
- a) 2) any form of income or price support within the meaning of Article XVI of the [GATT 1994](#); as well as*
 - b) the benefit provided in this way.*

1.2 A subsidy as defined in paragraph 1 shall fall within the provisions of [Part II](#) or [Parts III](#) or [V](#) only if it is targeted in accordance with the provisions of Article 2.

Subsidies in the gas market

Subsidies in the natural gas market are provided to all households (household consumers) without exception, regardless of their income level, in accordance with the Law of Ukraine "On Peculiarities of Regulation of Relations in the Natural Gas Market and Heat Supply Sector during Martial Law and Further Restoration of Their Functioning".

In addition, a PSO mechanism is in place on the natural gas market. For more details on price levels and other consumers covered by PSO, see Section 4.5.3.i.

These regulations define the mechanisms for ensuring subsidized prices for gas used by households (household consumers):

- directly (in the form of gas physically delivered to households);
- through district heating companies that generate heat and hot water for the needs of household consumers.

According to the Law On the Natural Gas Market, a market participant with special obligations is entitled to receive compensation for economically justified expenses (less income received in the course of PSO performance), taking into account the permissible level of profit. Such compensation is calculated in accordance with the procedure approved by the Resolution of the Cabinet of Ministers of Ukraine No. 1194 dated December 3, 2020⁴⁵¹.

District heating sector

The district heating system is also characterized by subsidized tariffs for heat and hot water supply for residential consumers. This subsidy is realized through a combination of subsidized gas prices for DH companies and support for DH companies from local budgets.

⁴⁵¹ <https://zakon.rada.gov.ua/laws/show/1194-2020-%D0%BF#n10>

This system was developed as a result of a combination of two factors:

- Implementation of the PSO mechanism in the gas market, which ensured regulated prices for gas supplied by Gas Supply Company Naftogaz Trading LLC to district heating companies for various needs;
- Transfer of powers to calculate and approve tariffs for heat and hot water supply from the NEURC to local governments.

Tariffs for heat and hot water supply for households in different cities differ significantly due to the economic parameters of the DH companies and the level of their budget support from local budgets.

Thus, a dual system of subsidization operates in the district heating sector - at the state and local levels. The heat tariffs approved by local councils often do not meet the requirements of the Law on Heat Supply, which requires that tariffs be no less than the cost of production. At the same time, during the martial law in Ukraine and for 6 months after its termination, Law No. 2479-IX of 29.07.2022 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 supply⁴⁵².

It should also be noted that subsidizing gas tariffs negatively affects heat production from renewable energy sources, in particular biomass. According to the legislation, there is a simplified mechanism for approving tariffs for a gigacalorie of heat produced from biomass at 90% of the cost of a gigacalorie produced from gas. Since the state subsidizes the price of natural gas under the PSO, the production of heat from biomass for the needs of the population does not make economic sense, and this leads to the following consequences:

- Investors are refusing to finance projects that use biomass to supply heat to households. Instead, they are investing in projects that supply heat to legal entities;
- CHP plants that use biomass to generate heat are either shutting down or being subsidized by local budgets.

Subsidies in the electricity market

The key regulatory acts that define the mechanisms of subsidization in the electricity market are the Resolution of the Cabinet of Ministers of Ukraine No. 483 "On Approval of the Regulation on the Imposition of Special Obligations on Electricity Market Participants to Ensure Public Interests in the Functioning of the Electricity Market"⁴⁵³ and the Law of Ukraine "On the Electricity Market"⁴⁵⁴. See also PM_IM_WEM_03 Regulation and Liberalization of Retail Prices.

Price subsidy mechanisms include those implemented through the PSO mechanism and/or involving the redistribution of funds in the market:

- Price subsidies for households;
- Subsidizing the production of electricity from renewable energy sources through a feed-in tariff.

The Guaranteed Buyer State Enterprise, established in June 2019 pursuant to CMU Resolution No. 324 of 17.04.2019 "On the Establishment of State Enterprises Guaranteed Buyer and Market Operator" to perform

⁴⁵² <https://zakon.rada.gov.ua/laws/show/2479-20#Text>

⁴⁵³ "Resolution of June 5, 2019, No. 483 "On Approval of the Regulation on the Imposition of Special Obligations on Electricity Market Participants to Ensure Public Interest in the Functioning of the Electricity Market" <https://zakon.rada.gov.ua/go/483-2019-%D0%BF>.

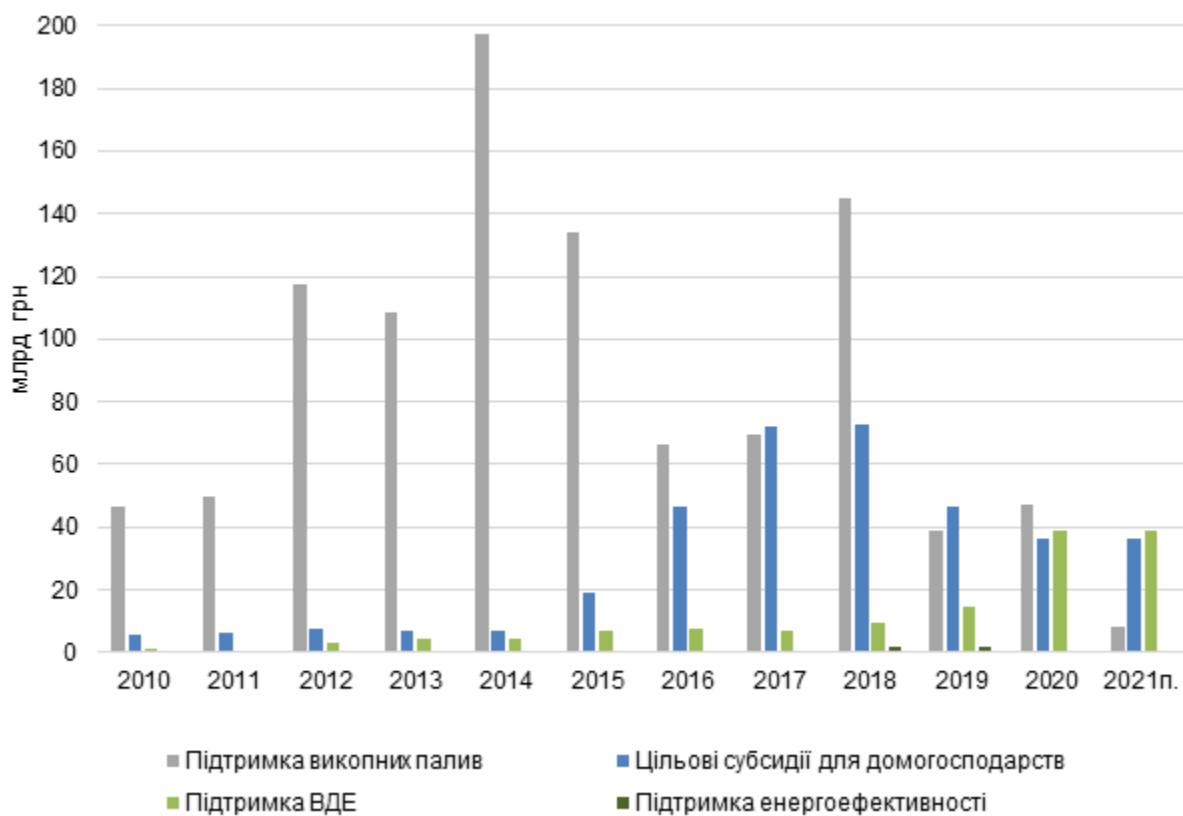
⁴⁵⁴ Law of Ukraine "On the Electricity Market." <https://zakon.rada.gov.ua/go/2019-19>.

the functions of a guaranteed buyer of electricity from renewable sources, is responsible for making payments under the feed-in tariff and ensuring the functioning of the PSO mechanism.

In order to ensure the supply of electricity to the population at lower than market prices, NNEGC Energoatom and Ukrhydroenergo compensate for the losses incurred by universal service providers (USPs) in the supply of electricity to the population. Given the significant costs of state-owned generating companies (in 2023 alone, Energoatom estimated the cost of PSO at UAH 128 billion⁴⁵⁵, Ukrhydroenergo - at UAH 23.67 billion⁴⁵⁶), these obligations make it impossible to direct investment resources to development programs, such as accumulating resources for the future decommissioning of nuclear power units.

Transformation of subsidies in the energy sector

Since the publication of the first comprehensive analysis of fossil fuel subsidies in Ukraine (OECD, 2018), the energy subsidy landscape has changed significantly. The graph below illustrates the evolution of state support for fossil fuel production and consumption, targeted subsidies to households, support for renewable energy sources, and energy efficiency.



Most of the energy used to generate energy for household consumption is also included in the "fossil" category. However, targeted subsidies for households are shown as a separate group, as this type of support is more efficient and is considered an acceptable form of social assistance for low-income households.

⁴⁵⁵ <https://www.energoatom.com.ua/o-1201241.html>

⁴⁵⁶ https://uhe.gov.ua/media_tsentr/novyny/ihor-syrota-ukrhydronerho-povnistyu-vykonalo-zobovyzannya-z-psoz-za-2023-rik

During 2014-2021, there was a clear trend towards the elimination of "general" fossil fuel subsidies, while the amount of targeted subsidies and privileges for households was increased to support the poor during the increase in utility tariffs. State support for fossil fuels peaked at UAH 197 billion in 2014, although the level in 2018 was also very high (almost UAH 145 billion), mainly due to cross-subsidies in the electricity sector and the need for domestic gas to be sold at regulated, below-market prices under the PSO regime⁴⁵⁷

In 2017 and 2019, the amount of targeted subsidies for households slightly increased the value of "total" fossil fuel subsidies. However, it should be noted that the estimates of subsidies for certain years should not be compared with each other, as in certain years, utility providers and Naftogaz received compensation for providing services at 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 in 2015-2019.

As electricity production from renewable energy sources is growing rapidly, the amount of support for renewables has increased more than 11-fold since 2012 to UAH 39 billion in 2020. At the same time, government support for energy efficiency remains minimal compared to subsidies in other sectors. In 2018 and 2019, the budget allocated about UAH 1.9 billion and UAH 1.8 billion, respectively, to support the Energy Efficiency Fund and the "warm loans" energy efficiency program. In the following years, funding for these programs was sharply reduced, partly due to the COVID-19 pandemic.

⁴⁵⁷ Prepared on the basis of previous estimates of fossil fuel subsidies in the Eastern Partnership countries published in the OECD report (2018), data of the Ministry of Finance of Ukraine (2020, 2018, 2017, 2014, 2013, 2010), NERC (2014), NEURC (2021, 2020, 2019, 2018, 2017, 2015), State Treasury Service of Ukraine (2021).

Table 4.14: State support for fossil fuel production and consumption in Ukraine, UAH mn⁴⁵⁸

Program.	Support mechanism	Indicator ⁴⁵⁹	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021n.
Restructuring of the coal and peat industry	direct transfer	PVE	1 059	1 597	1 078	1 178	355	206	107	244	n.d. ⁴⁶⁰	3 269	5 039	3 125
Decommissioning of unprofitable coal and peat mining enterprises	direct transfer	PVE	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	281	128	265	1 032
Rescue measures at coal mining enterprises	direct transfer	PVE	275	378.6	414	430	288	234	263	288	290	289	290	340
Prevention and response to emergencies at coal mines	direct transfer	PVE	n.d.	1.1	n.d.	0.4	n.d.	n.d.	n.d.	10	82	n.d.	n.d.	n.d.
Elimination of the emergency situation at the Luhansk-Lysychansk-Rubizhne gas pipeline	direct transfer	PVE	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	35	n.d.	n.d.	n.d.	n.d.
Emergency response at Vuhlehirkska TPP	direct transfer	PVE	n.d.	n.d.	n.d.	111	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Partial compensation of costs for the production of finished commercial coal	direct transfer	PVE	5 807	6 710	10 172	13 302	8 705	1 212	1 373	2 122	1 072	n.d.	n.d.	n.d.
Improving security measures at coal mining enterprises	direct transfer	PVE	70	134	260	197	3	n.d.	n.d.	99	n.d.	n.d.	n.d.	n.d.
Construction and technical re-equipment of coal and peat mining enterprises	direct transfer	PVE	337	1 719	1 293	343	54	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Replenishment of working capital or increase of authorized capital of coal mines to pay off wage arrears	direct transfer	PVE	n.d.	n.d.	n.d.	n.d.	n.d.	200	500	n.d.	n.d.	n.d.	n.d.	n.d.
Repayment of electricity arrears of state-owned coal mining enterprises	direct transfer	PVE	140	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	445	n.d.	n.d.
State support for the construction of Novovolynska mine No. 10	direct transfer	PVE	n.d.	n.d.	n.d.	n.d.	n.d.	146	50	70	35	62	n.d.	n.d.
Measures to support domestic coal production and reform the coal industry	direct transfer	PVE	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	1 671	n.d.	n.d.	n.d.
State support for PJSC Main Gas Pipelines of Ukraine	direct transfer	PVE	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	0.13	20	n.d.	n.d.	n.d.
Compensation of Naftogaz of Ukraine for the difference between the purchase price of imported natural gas and its sale for heat production for households	direct transfer	PSE	3 424	n.d.	3 900	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Transferring the budget of Smilakomuneteploenergo to prevent an emergency in the city of Smila due to the company's financial inability to pay for natural gas	direct transfer	PSE	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	15	n.d.	n.d.
Subvention from the state budget to local budgets to compensate for the difference between actual utility costs and established tariffs	direct transfer	PSE	n.d.	2 857	14 443	2 052	12423	4 685	n.d.	1 798	978	n.d.	n.d.	n.d.
Subventions from the state budget to local budgets for the provision of benefits and housing subsidies for utilities to low-income households	direct transfer	PSE	5 131	6 069	6 718	6 046	6 173	17 995	44 120	69 740	69 977	21 561	n.d.	n.d.
Subvention from the state budget to local budgets for the provision of benefits and housing subsidies for the purchase of solid and liquid household stoves and liquefied gas for low-income households	direct transfer	PSE	496	557	738	733	715	1 121	2 280	2 633	2 694	1 820	n.d.	n.d.

⁴⁵⁸ Prepared on the basis of previous estimates of fossil fuel subsidies in the Eastern Partnership countries published in the OECD report (2018), data of the Ministry of Finance of Ukraine (2020, 2018, 2017, 2014, 2013, 2010), NERC (2014), NEURC (2021, 2020, 2019, 2018, 2017, 2015), State Treasury Service of Ukraine (2021).

⁴⁵⁹ EPS - support for energy producers, PSE - support for energy consumers

⁴⁶⁰ n.a.: not applicable, -: no data available, p.: preliminary data.

Direct payments of benefits and housing subsidies to households to partially cover utilities, solid and liquid fuels, and liquefied natural gas costs	direct transfer	PSE	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	23 267	36 357	35 208
Repayment of wage arrears to employees of Nadiya Mine PJSC	direct transfer	PVE	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	51	n.d.
Compensation of Naftogaz of Ukraine for the supply of imported gas to PSO consumers	direct transfer	PSE	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	32 205	n.d.
Securing the acquisition of JSC Main Gas Pipelines of Ukraine by LLC Gas Transmission System Operator of Ukraine from OJSC Ukrtransgaz	direct transfer	PVE	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	3 851	n.d.
Compensation for consumers using electric heating for higher electricity prices	direct transfer	PSE	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	1 400
Total direct transfers			16 739.1	023.3	20 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 expenditures of energy companies planned under investment programs	tax benefit	PVE	n.d.	263	975	761	957	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Corporate income tax credit for the amount of excise tax levied on heavy distillates (gasoline) used in vehicles	tax benefit	PVE	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	735	639	n.d.	n.d.
Deduction of corporate income tax on expenses related to the exploration and organization of oil and gas fields	tax benefit	PVE	-	23	-	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Temporary VAT exemption for natural gas supply operations imported into the customs territory of Ukraine by Naftogaz of Ukraine	tax benefit	PVE	n.d.	575	1 464	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Temporary VAT exemption for the supply of coal and/or coal enrichment products in the customs territory of Ukraine	tax benefit	PVE	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	2 116	2 609	3 042	2 808	1 333	1 431
Excise tax exemption for LPG sales at specialized auctions for households	tax benefit	PSE	n.d.	13	69	78	78	14	14	109	65	57	n.d.	n.d.
Reduction of the excise tax rate for the sale of aviation gasoline and jet fuel produced in Ukraine and imported	tax benefit	PSE	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	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% owned by the state) to sell gas for household needs at regulated tariffs	indirect transfer	PSE	-	-	43 168	44 493	36 679	53 893	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Requirements for domestic gas producers to sell gas at regulated prices under the PSO regime	indirect transfer	PSE	n.d.	n.d.	n.d.	n.d.	n.d.	-	16404.7	25529.1	91092.72	n.d.	1683.45	n.d.
Cross-subsidization in the electricity sector	indirect transfer	PSE	23 326	28 048	34 467	37 557	40 825	43 848	45 466	36 595	45 344	26 053	n.d.	n.d.
Total indirect transfers			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.d.
Increase the authorized capital of Naftogaz through the mechanism of issuing government bonds to cover its deficit	transfer of risk to the government	PSE	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 risk transfer to the government			12 400	7 500	6 000	8 000	96 610	29 700	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
In total, all support mechanisms			2 465.5	445.4	56 125 158.8	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 measures and electricity produced from renewable energy sources, UAH mn⁴⁶¹

Program.	Support mechanism	Indicator ⁴⁶²	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021n.
Cheaper loans program	direct transfer	PSE	n.d. ⁴⁶³	1	n.d.	n.d.	n.d.	n.d.						
Energy efficiency program	direct transfer	PSE	11	282	57	n.d.	2	302	861	818	418	546	384	150
Energy Efficiency Fund	direct transfer	PSE	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	1 500	1 219	n.d.	100	
Total support for energy efficiency			11	283	57	n.d.	2	302	861	818	1 918	1 765	384	250
Exemption from corporate income tax in respect of profits of electricity producers that generate electricity exclusively from renewable energy sources	tax benefit	PVE	-	-	468	450	-	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Exemption from corporate income tax in respect of income of biofuel producers received from the sale of biofuels	tax benefit	PVE	120	-	15	15	15	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Exemption from corporate income tax in respect of income from combined heat and power plants using biofuels and heat energy using biofuels	tax benefit	PVE	-	-	548	0	0	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Zero excise tax rate on bioethanol used for the production of biofuels and bioethanol and gasoline fuel blends	tax benefit	PSE	1 153	-	752	788	183	776	1 663	532	569	-	-	-
VAT exemption on materials, supplies and equipment for the production of renewable energy sources, electricity generation from renewable sources, and energy service equipment, unless the same goods are produced in Ukraine	tax benefit	PVE	-	-	-	-	-	-	-	-	-	-	-	-
Exemption from import duties on materials, supplies and equipment for the production of renewable energy sources, electricity generation from renewable sources, and energy-saving equipment, if the same goods are not produced in Ukraine	tax benefit	PVE	-	64	-	-	-	-	-	-	-	-	-	-
Total tax benefits			1 273	64	1 783	1 253	198	776	1 663	532	569	-	-	-
"Green" tariff for producers of electricity from renewable sources (wind, solar, biomass, small hydropower, etc.)	indirect transfer	PVE	119	271	700	3 029	4 322	5 973	5 946	6 624	9 136	14 915	39 033	-
Total support for RES electricity producers			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 renewable energy sources			1 402	618	3 540	4 282	4 523	7 050	8 471	7 974	11 624	16 680	39 416	250

⁴⁶¹ Prepared on the basis of previous estimates of fossil fuel subsidies in the Eastern Partnership countries published in the OECD report (2018), data of the Ministry of Finance of Ukraine (2020, 2018, 2017, 2014, 2013, 2010), NERC (2014), NEURC (2021, 2020, 2019, 2018, 2017, 2015), State Treasury Service of Ukraine (2021).

⁴⁶² EPS - support for energy producers, PSE - support for energy consumers

⁴⁶³ n.a.: not applicable, -: no data available, p.: preliminary data.

5. ASSESSING THE IMPACT OF PLANNED POLICIES AND MEASURES

5.1. Impacts of the planned policies and measures described in [Section 3](#) on the energy system, GHG emissions and removals compared to projections based on existing policies and measures (as described in [Section 4](#)).

i. Forecasts of the development of the energy system and GHG emissions and removals, as well as, where applicable, air pollutant emissions in accordance with Directive (EU) 2016/2284 under the planned policies and measures for at least a ten-year period after the period covered by the plan (including the last year of the period covered by the plan), including relevant Union policies and measures.

The table below summarizes the main modeling and forecasting results obtained using the TIMES-Ukraine model and other modeling tools for GHG emissions in Ukraine under the scenario with additional (planned) policies and measures (with additional measures, WAM).

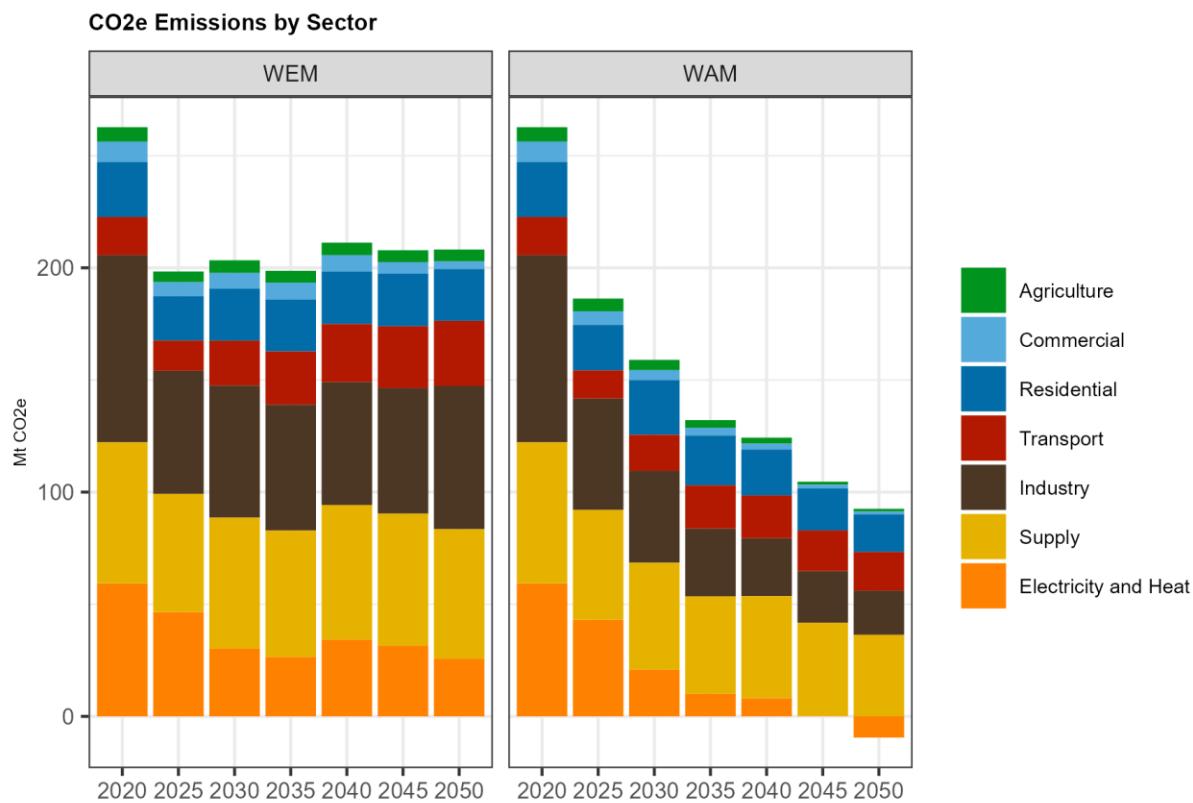
Table 5.1. Main results of modeling GHG emissions in Ukraine under the WAM scenario

Scenario with additional policies and measures (WAM)									
	1990	2015	2020	2025	2030	2035	2040	2045	2050
Total GHG emissions, million tons of CO₂-eq.²	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 from 1990 levels, %	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 CO ₂ -eq per capita	17	7	8	?	?	?	?	?	?
Carbon intensity of GDP									
t CO ₂ -eq./ 1 000 USD. USD GDP (at PPP)	1,6	1,0	0,9	?	?	?	?	?	?

Greenhouse gas emissions in the Energy and Industrial Processes and Product Use sectors

The figure below shows the projection of greenhouse gas emissions until 2050 in the Energy and Industrial Processes and Product Use sectors (as defined by the UN IPCC) with two scenarios WEM and WAM using the TIMES-Ukraine model.

Fig. 5.1. Greenhouse gas emissions in the Energy and Industrial Processes and Product Use sectors under the WEM and WAM scenarios, million tons of CO₂-eq.



The modeling results show that even the rapid recovery of Ukraine's economy in the post-war period, but subject to the "build back better" approach, implementation of energy efficiency measures, increased use of renewable energy sources, 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.

Under 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, they could stabilize by 2050 with economic growth. At the same time, the implementation of additional, only planned measures (WAM scenario) could lead to an even greater reduction in GHG emissions by 2030 (-39% compared to 2020) and a further significant reduction by 2050 (-71% compared to 2020). Moreover, under the WAM scenario, it is possible to achieve net-zero GHG emissions in the electricity and heat production sector earlier than 2050 with the achievement of negative CO₂ emissions due to the combination of bioenergy and carbon capture and storage (CCS) technologies.

Greenhouse gas emissions in the Agriculture sector

The WAM scenario envisages the spread of a number of technologies and approaches in agriculture (see Table 5.2) that will help reduce greenhouse gas emissions.

Table 5.2. Potential impact of emission reduction policies in agriculture

Politics.	Quantitative goals	Investment needs, mln. USD	Reduction of greenhouse gas emissions, tons of CO₂-eKB
Promoting the spread of minimum tillage technologies	5 million hectares	311	3000000
Promoting organic crop production	2 million hectares	-	2000000
Use of nitrogen fertilizers with slow or controlled release of nutrients	-	355	300000
Use of information and telecommunication technologies in crop production	-	4377	350000
Use of food additives that will help reduce GHG emissions from intestinal fermentation of farm animals	-	1382	1500000

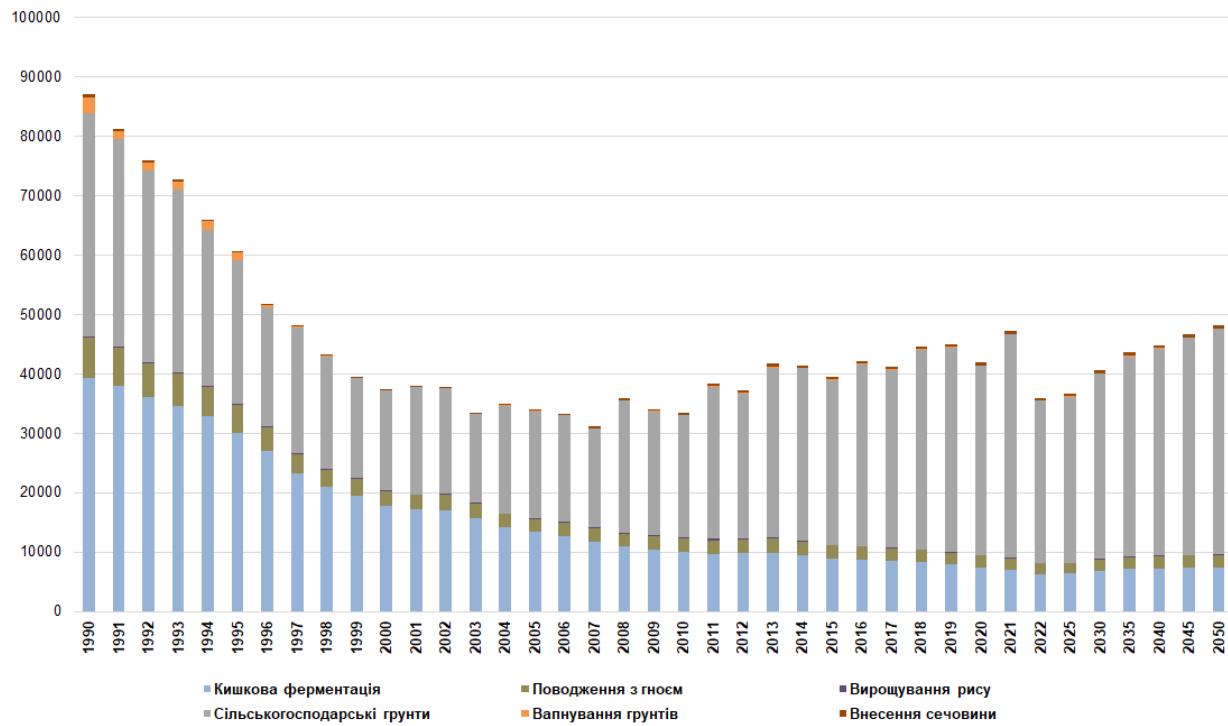
Given the historical trend of agricultural development, as well as uncertainty about the end of hostilities, we can assume a low degree of adoption of these practices and technologies (Table 5.3). However, even incomplete utilization of their potential will have an impact on reducing GHG emissions in agriculture.

Table 5.3. Greenhouse gas emission reductions as a result of policy implementation, t CO₂-eKB

Politics.	2025	2030	2035	2040	2045	2050
Promoting the spread of minimum tillage technologies	315000	2100000	2173500	2205000	2272238	2327250
Promoting organic crop production	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 telecommunication technologies in crop production	5250	35000	84000	105000	143500	175000
Use of food additives that will help reduce GHG emissions from intestinal fermentation of farm animals	22500	150000	360000	450000	615000	750000

Thus, GHG emissions in agriculture under the WAM scenario in 2030, 2040 and 2050 will amount to 40631.1 thousand tons of CO₂-eKB , 44888.1 thousand tons of CO₂-eKB and 48242.3 thousand tons of CO₂-eKB , respectively. Compared to the baseline year of 1990, greenhouse gas emissions projected under the WAM scenario in 2030, 3040 and 2050 will be 46.6, 51.5 and 55.4%, respectively.

Fig. 5.2. Forecast of emissions from agricultural activities in Ukraine under the WAM scenario, thousand tons of CO₂-eKB



Greenhouse gas emissions in the Waste sector

The WAM scenario is based on the successful implementation of the policies and measures (and the intensity of their implementation) of the WEM scenario. The WAM scenario takes into account strict compliance with the recently adopted Law on Waste Management in 2023, and the full implementation of the draft National Waste Management Plan of Ukraine until 2033⁴⁶⁴ and the draft Action Plan of the National Waste Management Plan of Ukraine until 2033⁴⁶⁵, which are planned to be approved in 2024. In more detail, the WAM scenario envisages a decrease in the share of solid waste disposal to 30% by 2033 and 20% in 2050; an increase in the share of landfill gas utilization to 23% in 2030 and 36% in 2050; 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 values typical for EU countries; utilization of methane generated during wastewater treatment will reach 41% in 2030 and 70% in 2050; specific water consumption per unit of GDP in 2050 will decrease to 0.5 compared to 2015. The full implementation of the WAM scenario will require the creation of an effective modern wastewater management system, including sewage sludge management and infrastructure for sewage sludge treatment. The methodology for developing the WAM scenario, estimating GHG emissions and capital investments in the sector is presented in Annex 3.

The list of key waste management policies under the WAM scenario is presented in Table 5.4 below. Detailed ways of implementing these policies in the field of solid waste management are defined in the

⁴⁶⁴ <https://mepr.gov.ua/wp-content/uploads/2023/12/proyekt-Natsionalnyj-plan-upravlinnya-vidhodamy-23.11-002.docx>

⁴⁶⁵ https://mepr.gov.ua/wp-content/uploads/2023/12/Dodatok-1.-Plan-zahodiv-NPUV_23.11-1.docx

draft National Waste Management Plan of Ukraine until 2033 and the draft 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 the key policy	Quantitative indicator		
		2030	2033	2050
1	Promote the practice of reusing MSW components	8 %* (full realization of the trend of implementation of the planned policies)	10 %* (full implementation of planned policies)	10 %*
2	Spreading the practice of solid waste recycling	26 %* (full realization of the trend of implementation of the planned policies)	34 %* (full implementation of planned policies)	35 %*
3	Promote the practice of composting organic components of solid waste	12 %* (full realization of the trend of implementation of the planned policies)	16 %* (full implementation of planned policies)	20 %*
4	Spreading the practice of thermal treatment of solid waste (with the production of useful energy)	8 %* (full realization of the trend of implementation of the planned policies)	10 %* (full implementation of planned policies)	15 %*
5	Increase the volume of landfill gas utilization (recovery and flaring) at landfills and waste dumps	23 %** (the quantitative indicator is not explicitly established by law)	29 %**	36 %**
6	Implementation of methane utilization (recovery and flaring) at wastewater treatment facilities	41 %** (the quantitative indicator is not explicitly established by law)	45 %**	70 %**

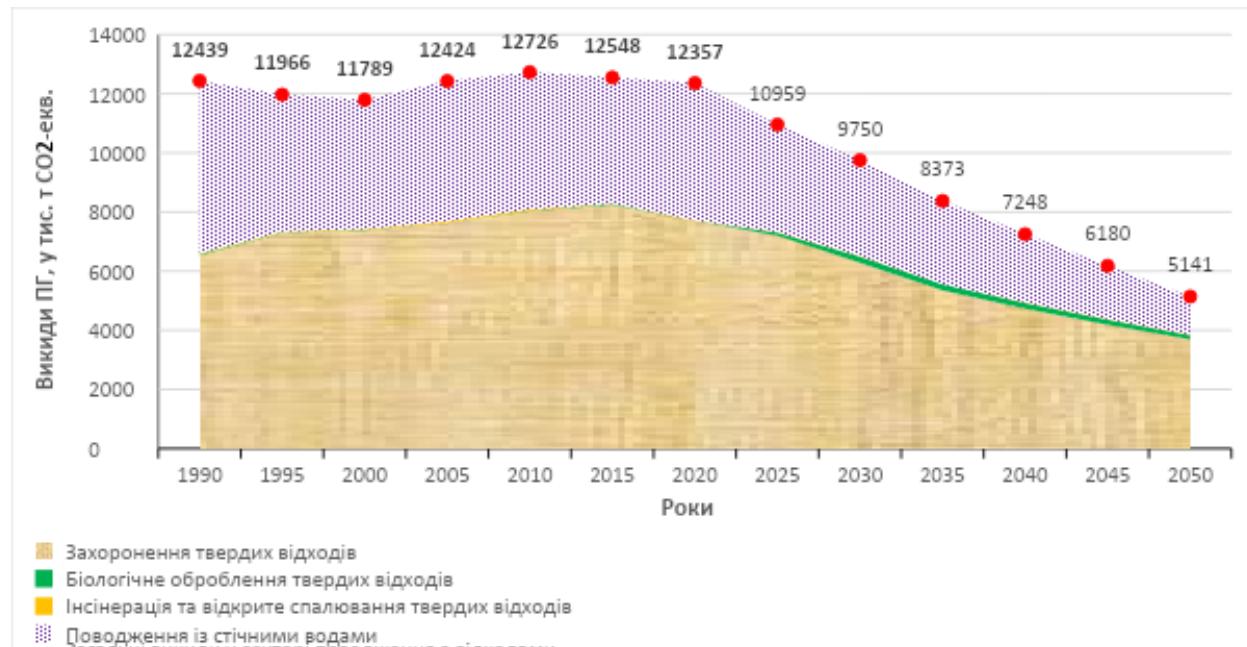
* - share of the total amount of waste generated;

** - share of the total amount of methane produced.

According to the WAM scenario, GHG emissions in the waste management sector will be reduced intensively and in 2030 will reach 9.7 million CO₂ -eq, which is 22% lower than in 1990. Further, emissions

will continue to decline and in 2050 will amount to 5.9 million tons of CO₂ -eq, which is 37% less than in 1990. Detailed GHG emissions in the waste management sector by 2050 are shown in Figure 5.3.

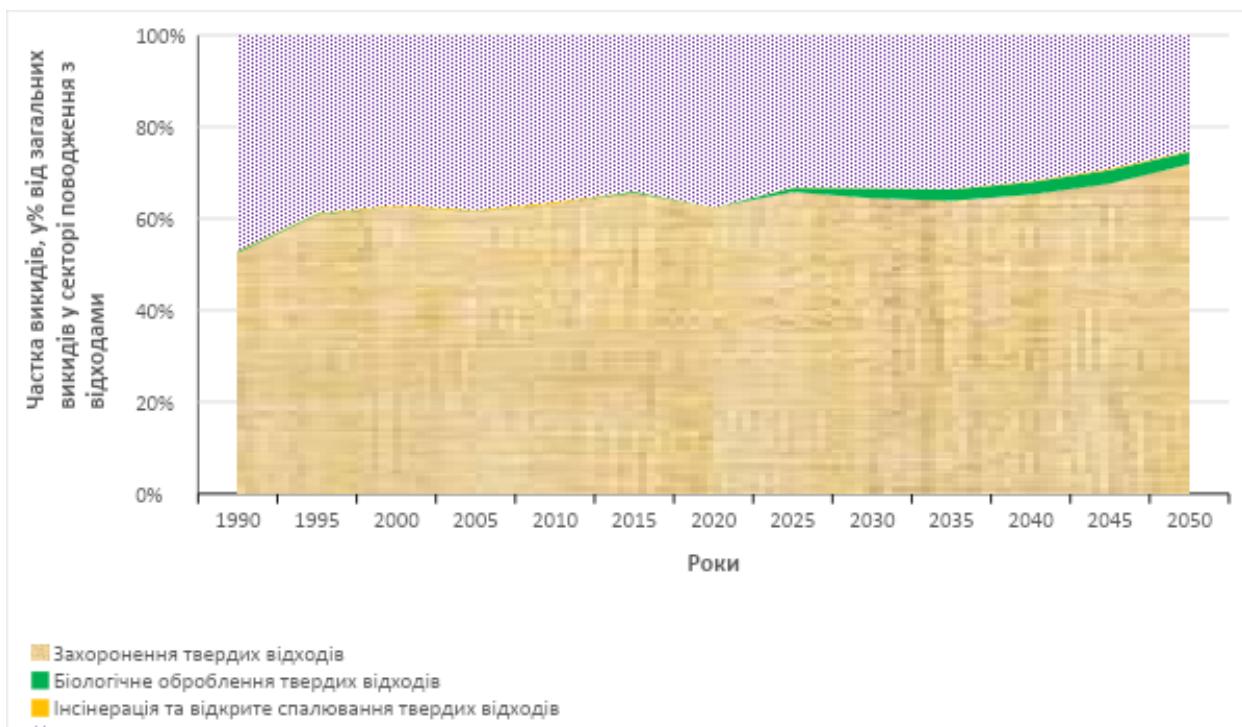
Figure 5.3. GHG emissions from the waste management sector under the WAM scenario; statistical data for the period 1990-2020, and projected data for the period 2025-205



Under the WAM scenario, the structure of emissions in the waste management sector will undergo significant changes. Thus, solid waste landfills will remain the main source of GHG emissions in the sector, but their share will increase from 62% in 2020 to 64% in 2030, and to 72% in 2050. Such changes are associated with the inevitable methane emissions that will occur as a result of the biodegradation of solid waste, which was disposed of in large volumes at landfills and dumpsites earlier (in the period up to 2024). The share of emissions related to wastewater management will decrease accordingly, amounting to 33% in 2030 and 25% in 2050, compared to 38% in 2020. As in the WEM scenario, in the WAM scenario, the only source where GHG emissions are expected to increase significantly is biological treatment of solid waste, with emissions from which increasing from 7.5 thousand tons of CO₂ eq. (0.1% of total emissions in the sector) 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 emissions in the sector) in 2050. Such a multiple increase in emissions from biological treatment of solid waste in the period up to 2030 will be caused by the intensive spread of solid waste composting in Ukraine.

The gradual reduction of GHG emissions from biological treatment of solid waste after 2030 will be associated with the introduction of modern technologies for composting organic components of MSW with lower methane and nitrous oxide emission factors. Greenhouse gas emissions from thermal waste treatment methods (*note: without useful energy recovery*) will increase from 0.1% of total waste management sector emissions 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 a significant reduction in GHG emissions from other sources. The detailed structure of emissions by individual types of activities in the waste management sector by 2050 is shown in Figure 5.3.

Figure 5.4. Structure of GHG emissions in the waste management sector under the WAM scenario; statistical data for the period 1990-2020, and projected data for the period 2025-2050



In the WAM scenario, the main factors that will determine the trends in GHG emissions in the waste management sector are:

- intensive reduction of the share of landfilling by 2033, followed by a more moderate reduction by 2050;
- Intensive deployment of landfill gas recovery and flaring technologies in the period up to 2033, followed by a moderate increase in the share of recovery by 2050;
- intensive deployment of technologies for methane recovery generated in the process of centralized wastewater treatment;
- Reduction of specific methane and nitrous oxide emissions from solid waste composting after 2033.

The key risks to reducing GHG emissions under the WAM scenario are:

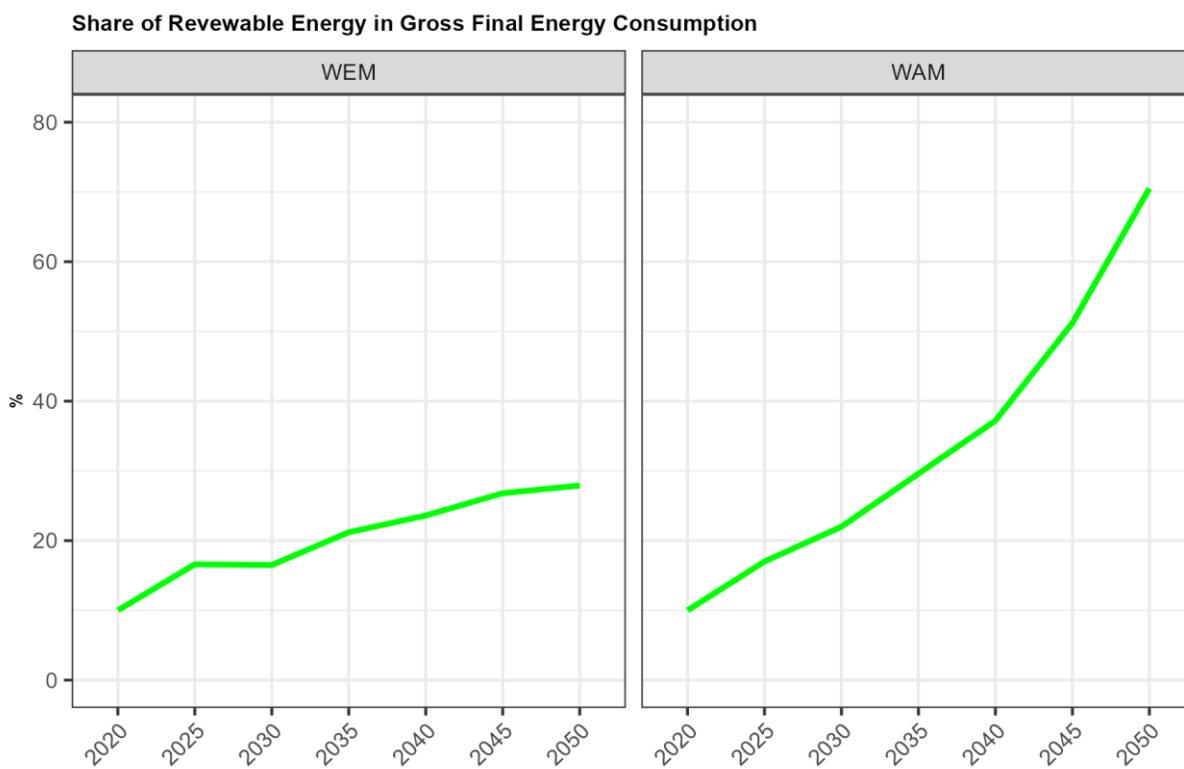
- Slow deployment of solid waste processing infrastructure;
- Critically slow implementation of methane recovery technologies at wastewater treatment plants;
- Low efficiency of flaring and landfill methane recovery technologies at landfills and dumpsites;
- introduction of technologies and practices for composting organic components of MSW with high specific methane and nitrous oxide emissions.

Taking into account the current and potential consequences of Russia's full-scale military aggression against Ukraine, the target of 27% of RES in the structure of gross final energy consumption seems extremely ambitious. The modeling results of both WEM and WAM scenarios show that the share of RES will grow steadily, but the target by 2030 may be unattainable, primarily due to low penetration of RES in industry and low rates of replacement of natural gas with renewable energy sources for individual heating in the

residential and commercial sectors. At the same time, the draft National Renewable Energy Action Plan until 2030 is currently being reviewed by the Ministry of Energy and the Ministry of Infrastructure. If the targets are recalculated and new policies in the RES sector are included, the modeling results will be revised at the next stages of work on the NECP.

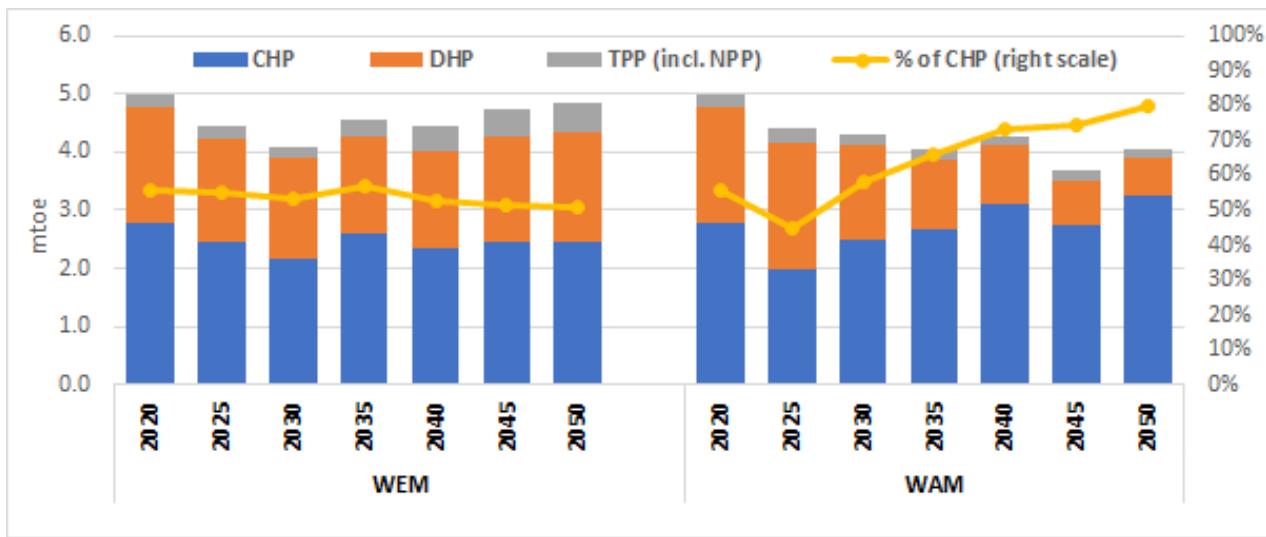
However, if additional (to the existing) measures are taken to stimulate the development of renewable energy, the share of RES could grow significantly after 2030, reaching 70% in the structure of gross final energy consumption in 2050 (Figure 5.5).

Fig. 5.5. Share of RES in the structure of gross final energy consumption, %.



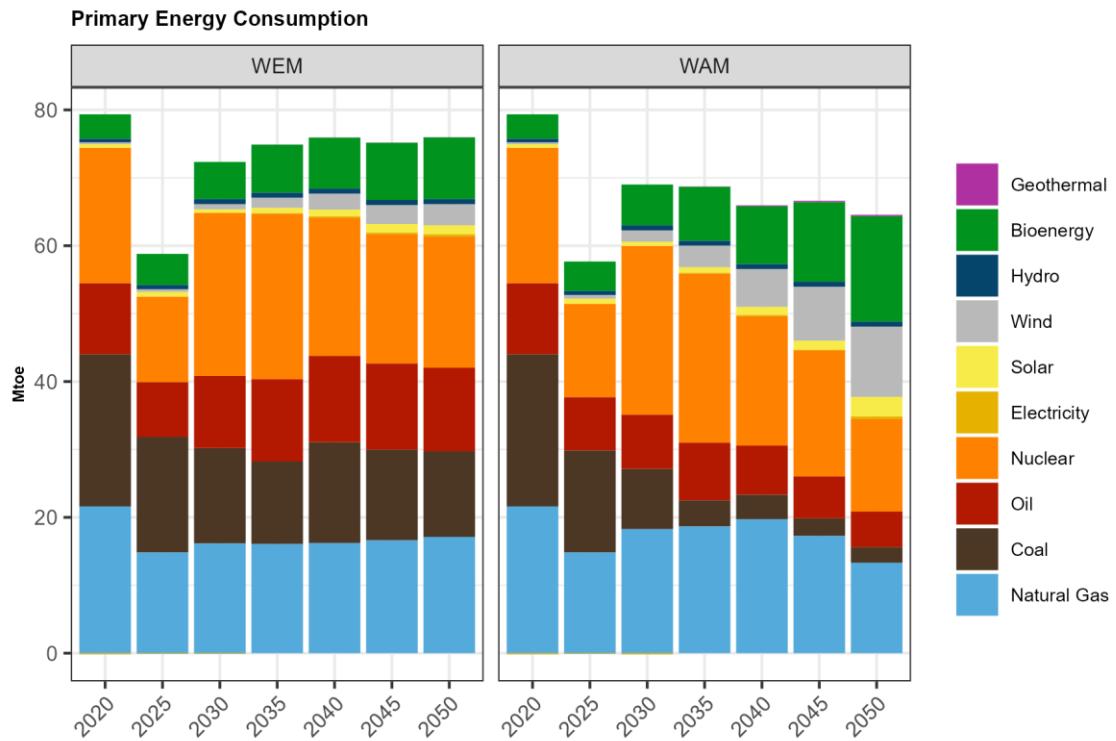
The results of modeling WEM and WAM scenarios using the TIMES-Ukraine model show that highly efficient cogeneration (CHP, especially on RES) will increasingly win competition from boiler houses (Figure 5.6).

Fig. 5.6. Thermal energy production in the WEM and WAM scenarios, Mtoe.



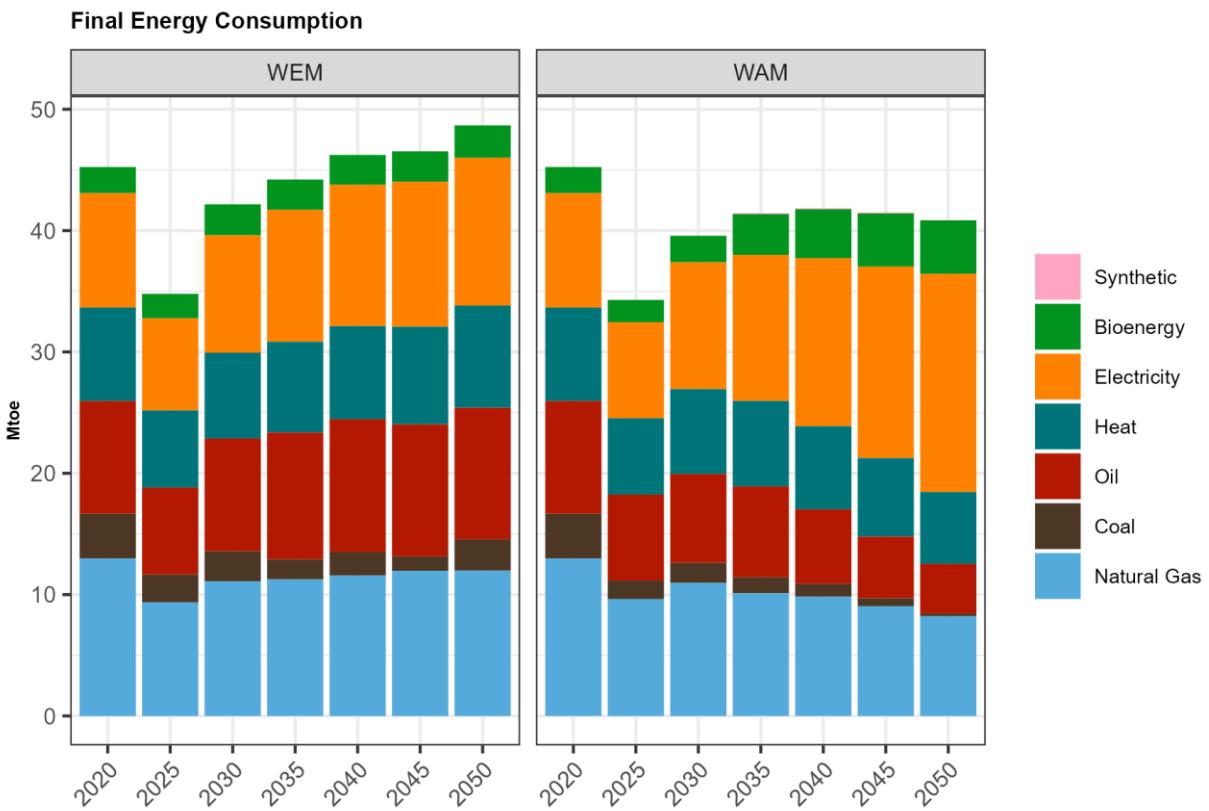
In addition, the modeling results of both scenarios (WEM and WAM) confirm that the post-war economic recovery and reintegration of the temporarily occupied territories of Ukraine will contribute to a significant increase in demand for energy resources, especially in the first 5-10 years. At the same time, existing policies and measures in the field of energy efficiency and renewable energy will not ensure stabilization of primary energy consumption, while additional measures may contribute to its reduction after 2030, with the share of natural gas remaining significant (Figure 5.7).

Fig. 5.7. Primary energy consumption, million tons of oil equivalent.



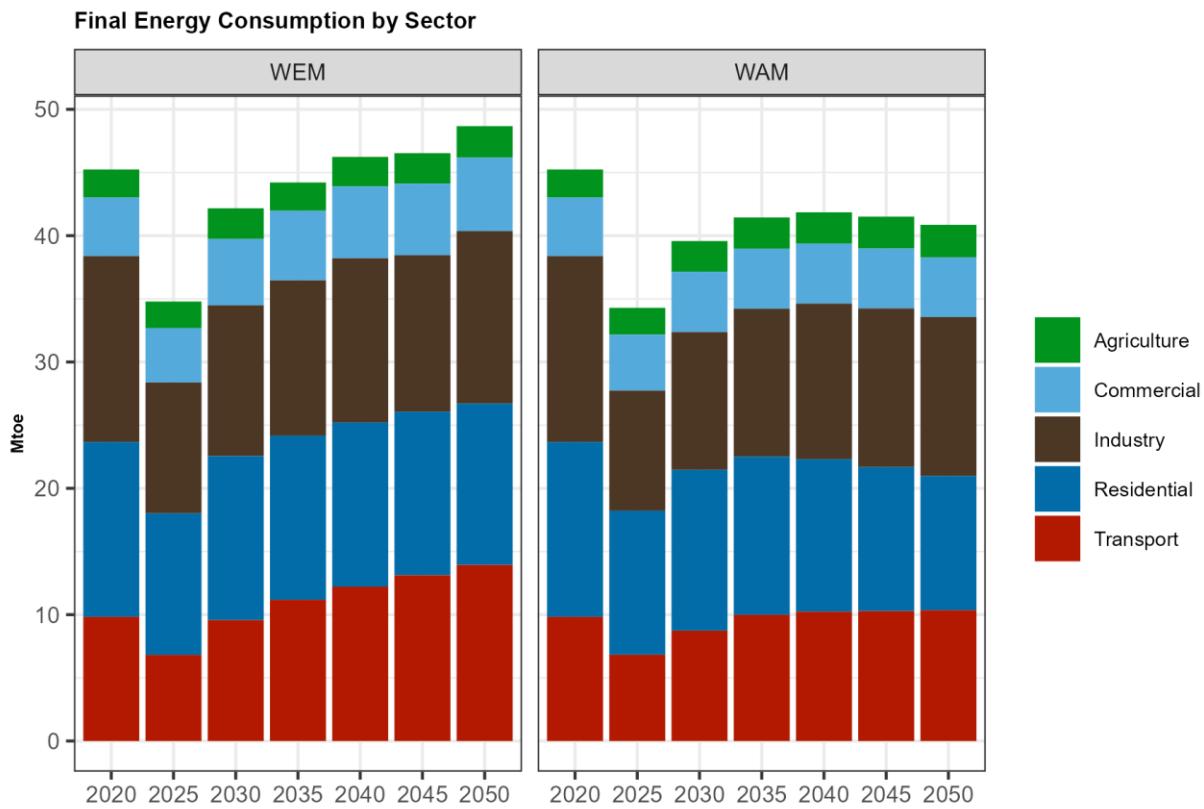
The trajectory of final energy consumption is similar to the trajectory of primary energy consumption, but the growth rate in the WEM scenario is slightly higher, and in the WAM scenario, final energy consumption stabilizes, which indicates an increase in the efficiency of the energy transformation sector in both scenarios, primarily 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 show competitiveness without special measures to support them.

Fig. 5.8. Final consumption by types of energy, million tons of oil equivalent.



After a radical drop in energy consumption in 2022 as a result of the full-scale invasion of Ukraine by the Russian Federation, all sectors of final energy consumption will see an increase in energy demand caused by economic recovery and reintegration of the temporarily occupied territories, which will continue until 2030. At the same time, additional planned measures for energy efficiency, RES development and other dimensions of the NEC will reduce energy needs in all sectors.

Fig. 5.9. Final energy consumption by sectors, million tons of oil equivalent.



ii. Assessment of policy interactions (between existing policies and measures and planned policies and measures within a policy dimension, as well as between existing policies and measures and planned policies and measures across dimensions) at least until the last year of the plan period, in particular to fully understand the impact of energy efficiency/energy saving policies on the energy system scale and reduce the risk of unjustified investments in energy supply

Table 5.5. Final energy consumption by sectors and fuel types, million tons of oil equivalent

	WEM scenario				WAM scenario			
	2020	2030	2040	2050	2020	2030	2040	2050
Final energy consumption in the service sector								
ECE in the services sector, million tons of oil equivalent.	4,8	5,4	5,8	5,9	4,8	4,84	5,05	5,17
Coal, %.	4,7	2,9	1,5	0,3	4,7	2,8	0,4	
Gas, %.	14,6	14,8	12	6,4	14,6	12,6	3,5	0,7
Crude oil, %.	4,9	2,5	0,7	0	4,9			
Thermal energy, %.	44,9	35	35,3	46,1	44,9	44,0	49,2	49,3
Electricity, %.	28,6	27,4	27,3	28,1	28,6	29,6	30,8	31,6
RES, %.	2,2	17,4	23,2	19,2	2,2	39,1	68,0	70,7
Solar energy, %.	0	0,1	0,4	1,5	0	2,0	3,5	5,4
Final energy consumption in industry								

CES in industry, million tons of oil equivalent.	14,7	11,9	13	13,7	14,7	12,1	17,4	19,0
<i>Coal</i>	15,0	18,2	13	17,5	15,0	10,3	3,6	
<i>Gas</i>	42,3	19	14,8	11	42,3	26,5	21,5	10,8
<i>Oil</i>	2,2	1,7	1,3	0,9	2,2			
<i>Thermal energy</i>	18,5	18,1	19,3	19,1	18,5	22,4	15,0	10,3
<i>Electricity</i>	21,7	33,8	41	40,8	21,7	32,2	43,8	58,0
<i>RES</i>	0,4	1,9	2,7	3,2	0,4	21,0	39,1	56,3
Final energy consumption in the residential sector								
CES in the residential sector	13,8	13	13	12,8	13,8	13,0	12,1	10,2
<i>Coal</i>	1	1	1	1,1	1	0,7		
<i>Gas</i>	48,8	52,9	56,9	62,9	48,8	51,4	48,9	27,4
<i>Oil</i>	0,2	0	0,8	0	0,2			
<i>Thermal energy</i>	14	13,4	12,9	12,5	14	9,9	9,6	15,2
<i>Electricity</i>	21,9	22,1	22,5	22,1	21,9	22,8	26,9	33,6
<i>RES</i>	14,1	10,7	5,9	1,5	14,1	24,4	32,9	48,7
<i>Solar energy</i>	0	0,1	0,1	0,5	0	0,5	1,2	2,9
Final energy consumption in the transportation sector								
CES in the transportation sector, million tons of oil equivalent.	9,8	9,6	12,2	14	9,8	7,1	9,5	10,0
<i>Coal</i>	0,1	0,1	0,1	0,1	0,1	0,1	0,1	
<i>Gas</i>	16,5	10,1	11,3	13,4	16,5	5,5	10,5	1,3
<i>Oil</i>	75,7	79,5	76,2	67,3	75,7	66,9	51,8	31,9
<i>Electricity</i>	7,2	9,5	11,6	11,4	7,2	19,4	20,0	32,0
<i>RES</i>	0	0,2	0,3	7,2	0	12,8	24,9	48,8
Final energy consumption in agriculture								
CES in agriculture, million tons of oil equivalent.	2,3	2,5	2,4	2,5	2,3	2,3	2,2	2,3
<i>Coal</i>	0,6	0,6	0,6	0,6	0,6	0,4	0,2	
<i>Gas</i>	8,5	8,5	8,3	7,9	8,5	7,1	4,8	
<i>Oil</i>	60,5	60,7	59,3	55,1	60,5	48,4	28,6	
<i>Thermal energy</i>	14,2	14,2	14,3	14,5	14,2	14,0	13,8	13,4
<i>Electricity</i>	15	14,9	14,8	14,9	15	15,7	15,7	11,5
<i>RES</i>	1,2	1,2	2,8	7,2	1,2	31,1	57,9	94,5

Figures 5.10 and 5.11 show the impact of additional (planned) thermo-modernization policies and measures on reducing heating and cooling demand in these sectors from the introduction of new building codes in the residential and service sectors, respectively. As can be seen from these figures, by 2030, such measures can reduce about 8% of total energy needs to meet heating and cooling demand, and by 2050, this contribution could be 27-28%, i.e. more than a quarter of the needs, without taking into account the improvement of energy efficiency of equipment, household appliances, etc.

Fig. 5.10. Impact of policies and measures for thermal modernization and introduction of new building codes in the residential sector, Mtoe

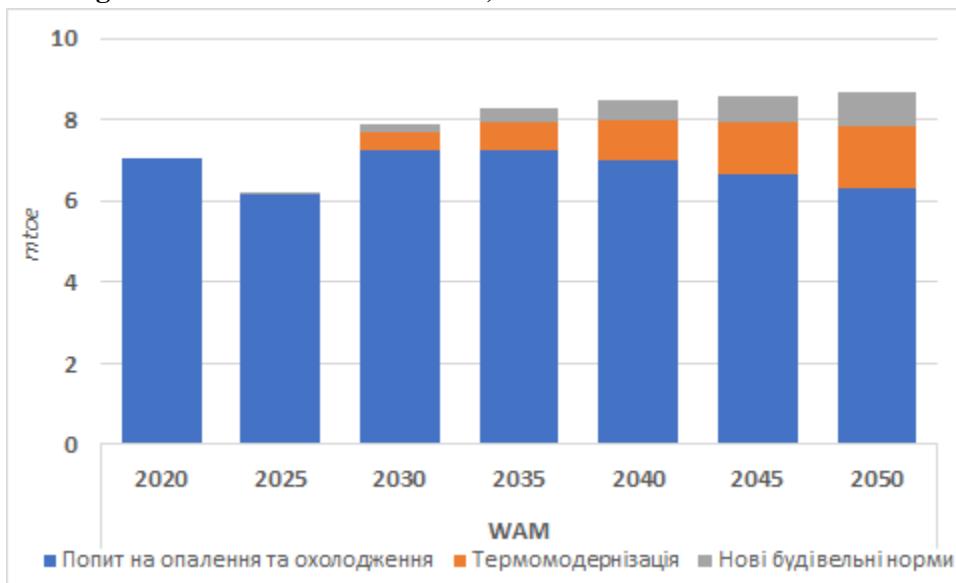


Fig. 5.11. Impact of policies and measures for thermal modernization and introduction of new building codes in the residential sector, Mtoe

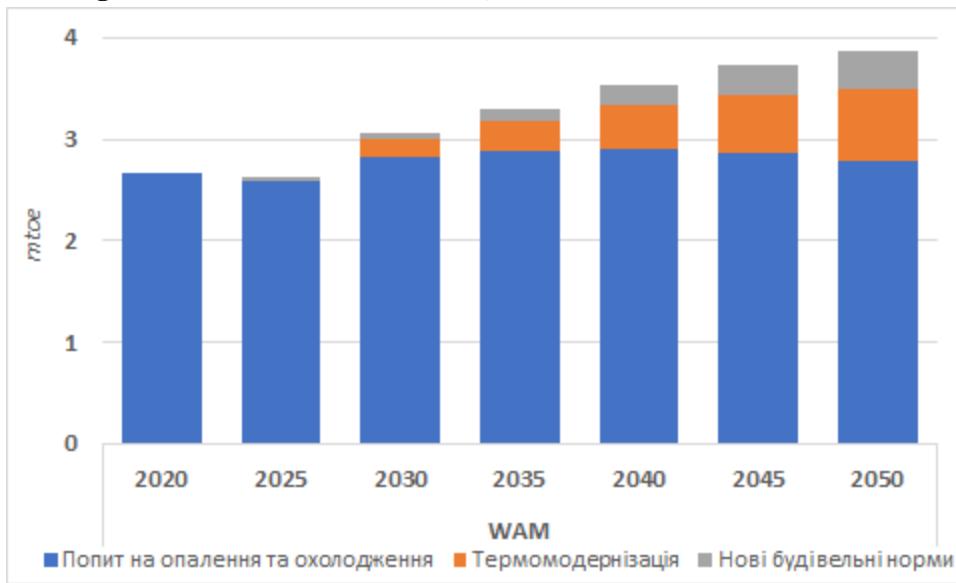


Figure 5.12 shows the impact of policies and measures on specific energy consumption under different scenarios in the residential (population) and service (commercial) sectors.

Fig. 5.12. Specific energy consumption per 1 m² in the residential sector (Fig. 5.12a) and per 1000 UAH of value added in the service sector (Fig. 5.12b)

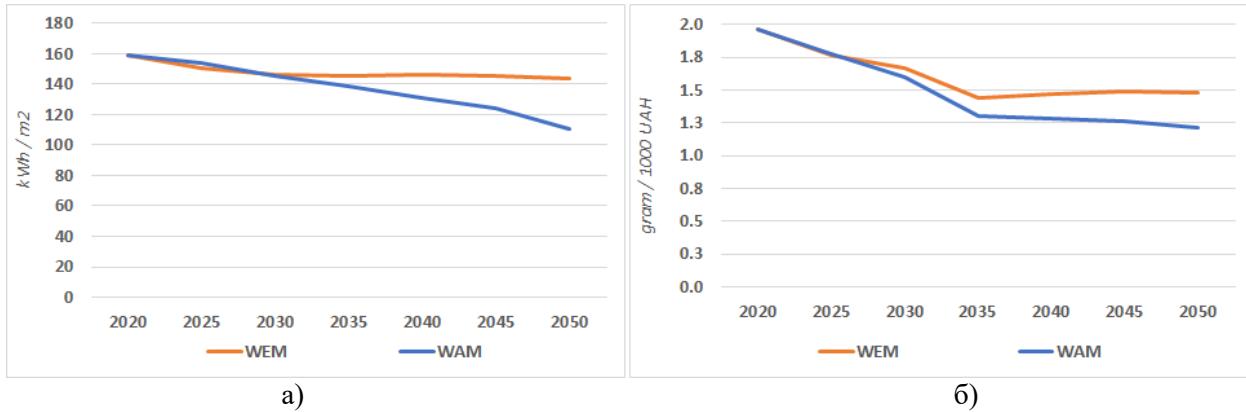
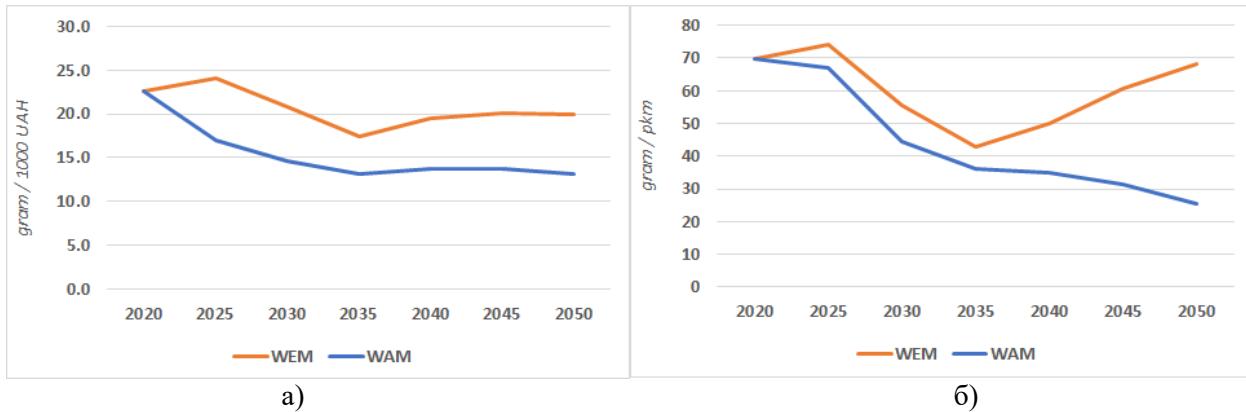


Figure 5.13 shows the specific energy consumption per 1000 UAH of value added in industry (Fig. 5.13a) and the specific energy consumption per passenger-kilometer (the number of passengers traveling 1 km on average per year) (Fig. 5.13b).

Fig. 5.12. Specific energy consumption per 1000 UAH of value added in industry (Fig. 5.12a) and passenger-kilometer in transport (Fig. 5.12b)



iii. Assessment of the interaction between existing policies and measures and planned policies and measures, as well as between such policies and measures and the Union's climate and energy policy measures

According to both WEM and WAM scenarios, primary and final energy consumption in Ukraine will not exceed the 2030 target set by the Energy Community (Figures 5.13 and 5.14), which is in line with the Energy Community's climate and energy policies.

Fig. 5.13. Primary energy consumption in Ukraine and targets for the Energy Community member states, million toe

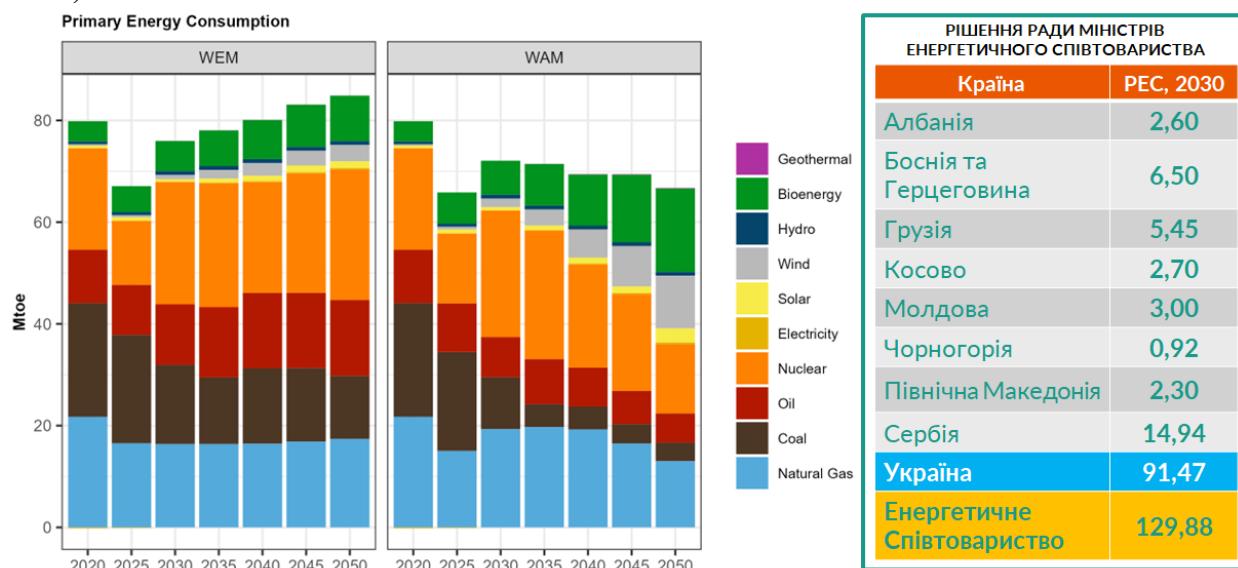
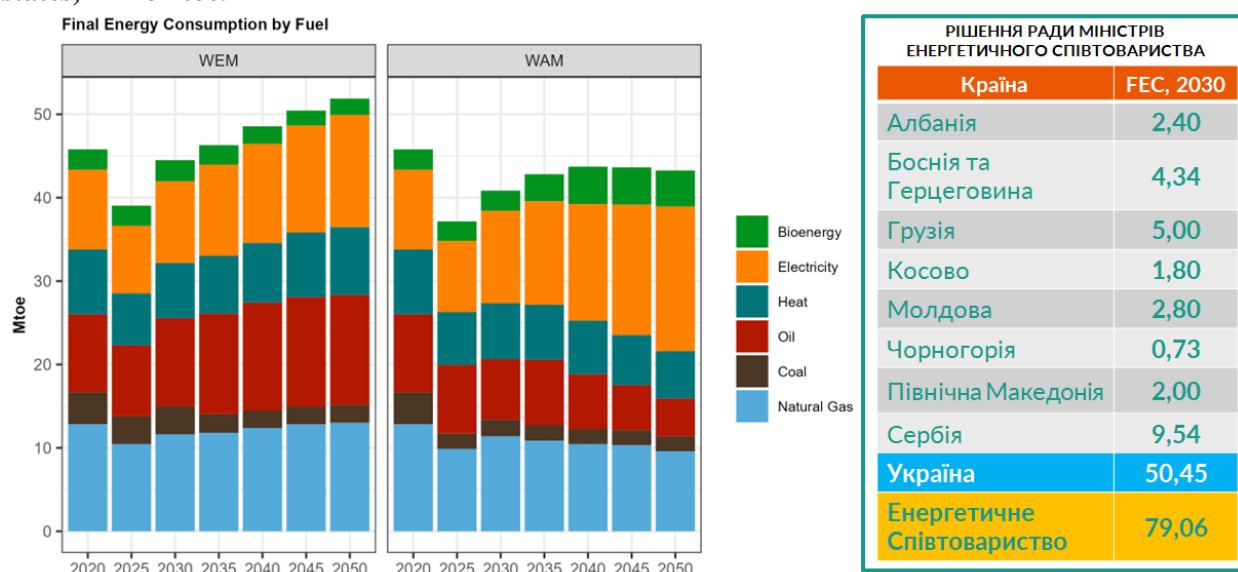


Fig. 5.13. Final energy consumption in Ukraine and targets for the Energy Community member states, million toe.



5.2. Macroeconomic impacts and, to the extent possible, health, environmental, employment, education and skills, and social impacts, including aspects of equitable transition (in terms of costs and benefits and cost-effectiveness) of the planned policies and measures described in [section 3](#), at least up to the last year of the period covered by the plan, including a comparison with projections based on existing policies and measures

At this stage, no assessment of the impact of the implementation of the scenarios with existing policies and measures (WEM) and planned policies and measures (WAM) on macroeconomic indicators was conducted. However, we can draw an analogy with the study of the macroeconomic impact of the implementation of the scenarios of Ukraine's updated Nationally Determined Contribution to the Paris Agreement, which was

conducted within the framework of the EBRD project "Support to the Government of Ukraine for the Update of the NDC"⁴⁶⁶ and described in detail in the Modeling Report of the Institute for Economics and Forecasting of the National Academy of Sciences of Ukraine⁴⁶⁷. According to this study, among the policy options analyzed in the study, the path of intensive investment in energy efficiency technologies is the most attractive from both a macroeconomic and sectoral perspective. If this option is pursued, there are significant benefits for both the economy and the environment. In the case of higher levels of investment and improvements in energy efficiency and relatively low GHG emission reduction prices until 2035-2040, GDP will grow at a higher rate. At the same time, after 2035, as a result of a higher level of ambition to reduce GHG emissions and a corresponding increase in the *price of carbon*, additional GDP growth will slow down. A similar situation will be with household income. The population will face higher *carbon prices*, which will affect their purchasing power. At the same time, even during the period of 2040-2050, when the *carbon price* exceeds the level of USD 100/ton of CO USD/ton of CO₂-eq., the population will still see an increase in real income compared to the baseline scenario. Improvements in energy efficiency play a key role in making this happen, thanks to a significant reduction in production costs and correspondingly lower prices for end-users in households.

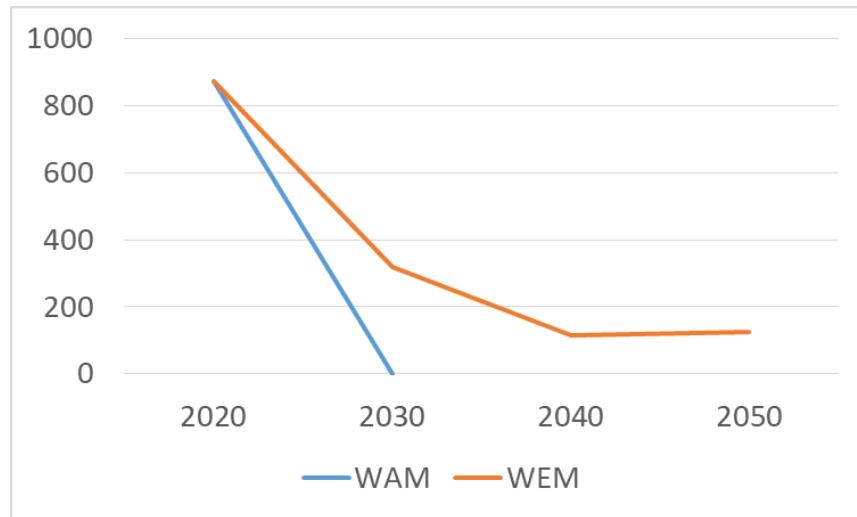
In addition, under ambitious energy and climate scenarios, significant transformations in the structure of production may be observed, leading to significant reductions in GHG emissions and energy intensity of GDP. This is especially true for scenarios with high carbon prices, such as coke and coal production/mining, which could fall by more than 75% in 2050. Other energy-intensive sectors, such as metallurgy, petrochemicals, utilities, and metal processing, could also significantly reduce their production. At the same time, there is a reorientation towards sectors that generate investment and related services. The latter include increased production in the programming and research sector. The construction sector is increasing its output as a key supplier of inputs to the production of goods. The increase in food production and agriculture is mainly driven by increased exports of these goods.

As can be seen from Figure 5.14, under the WEM scenario, pollutant emissions follow the trajectory defined by the NERP. At the same time, under the WAM scenario, coal-fired power units at TPPs and CHPPs are decommissioned by 2030, resulting in the elimination of air pollutant emissions, which cannot but have a positive impact on the environment and public health, reducing the risk of respiratory and circulatory system diseases and vulnerability to respiratory viral infections.

⁴⁶⁶ <https://www.ebrd.com/ukraine-es-ukr.pdf>

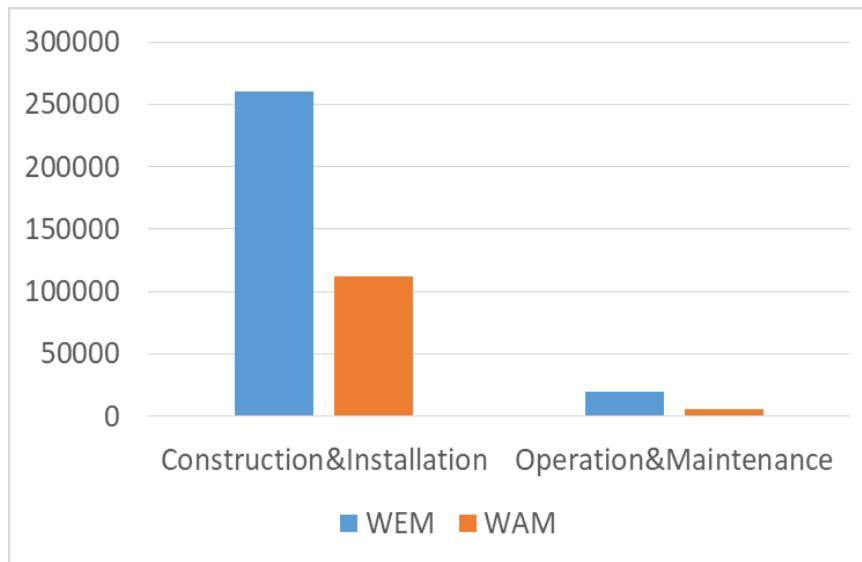
⁴⁶⁷ Dyachuk O., Podolets R., Chepelev M. et al. Modeling report of the EBRD Project "Support to the Government of Ukraine on updating the Nationally Determined Contribution" [Electronic resource] // Ministry of Environmental Protection and Natural Resources of Ukraine: <https://menr.gov.ua/news/35316.html>.

Fig. 5.14. Total pollutant emissions from large combustion plants, thousand tons



Using NREL data, we calculated the projected number of jobs (person-years) at new power plants, separately for construction and maintenance (Figure 5.15). Implementation of the WEM scenario allows to provide more than twice as many jobs. At the same time, 83% of construction jobs and 87% of maintenance jobs are related to RES.

Figure 5.15. Projected number of jobs created by construction and maintenance of new power plants in WEM and WAM scenarios



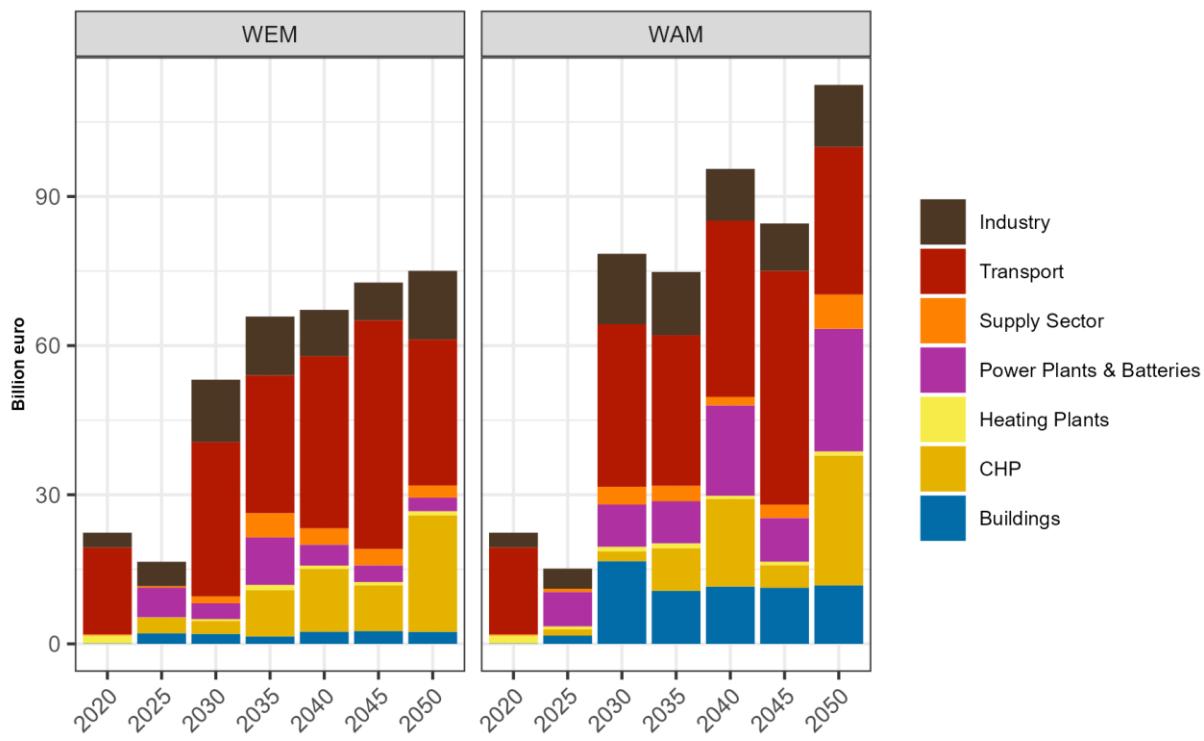
5.3. Overview of investment needs

i. Existing investment flows and prospective investment forecasts in the context of planned policies and measures

Investment needs in the Energy and Industrial Processes and Product Utilization sectors

The overall investment needs are high in both scenarios, but quite comparable. In both scenarios, the largest investment needs are for the renewal and decarbonization (electrification) of the vehicle fleet (excluding household vehicles). Investments in electricity and heat generation facilities are also significant, however, due to the higher rate of thermal modernization of buildings, investment needs for cogeneration in the WAM scenario will be lower than in the WEM scenario.

Fig. 5.16. Investment needs for the implementation of WEM and WAM scenarios



Investment needs in the Agriculture sector

The investment needs for achieving the projected greenhouse gas emissions under the WAM scenario in stages are shown in Table 5.6.

Table 5.6. Investment needs for the implementation of WAM policies in the agricultural development scenario, mln. USD

Politics.	2030	2040	2050
Promoting the spread of minimum tillage technologies	217,7	10,9	12,7
Promoting organic crop production	-	-	-
Use of nitrogen fertilizers with slow or controlled release of nutrients	248,5	12,4	14,5
Use of information and telecommunication technologies in crop production	437,7	875,4	875,4
Use of food additives that will help reduce GHG emissions from intestinal fermentation of farm animals	138,2	276,4	276,4

Investment needs in the Waste sector

To implement the WEM scenario in the Waste sector, it is necessary to attract about EUR 2.6 billion of capital investments in the period from 2024 to 2030 inclusive. In general, the implementation of the WEM scenario will require about EUR 7.3 billion of capital investment in the waste sector over the period 2024-2050.

To implement the WAM scenario, it is necessary to attract about EUR 3.6 billion in the period from 2024 to 2030 inclusive. In total, the WAM scenario will require about EUR 12.1 billion in capital investment. Table 5.6 and Table 5.8 show the capital investment requirements for the WEM and WAM scenarios on a cumulative basis over the period 2024-2050 and for individual periods, respectively.

Table 5.7. Capital investments for the implementation of WEM and WAM scenarios, cumulative until 2050, in millions of euros

	2025	2030	2035	2040	2045	2050
Waste management sector, cumulative total						
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 5.8. Capital investments for the implementation of WEM and WAM scenarios by selected periods up to 2050, in millions of euros

	2024- 2025	2026- 2030	2031- 2035	2036- 2040	2041- 2045	2046- 2050	Total
Waste management sector, for the 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. sectoral or market risk factors or barriers in the national or regional context

-

iii. an analysis of additional support from public funds or resources to address the gaps identified in point ii

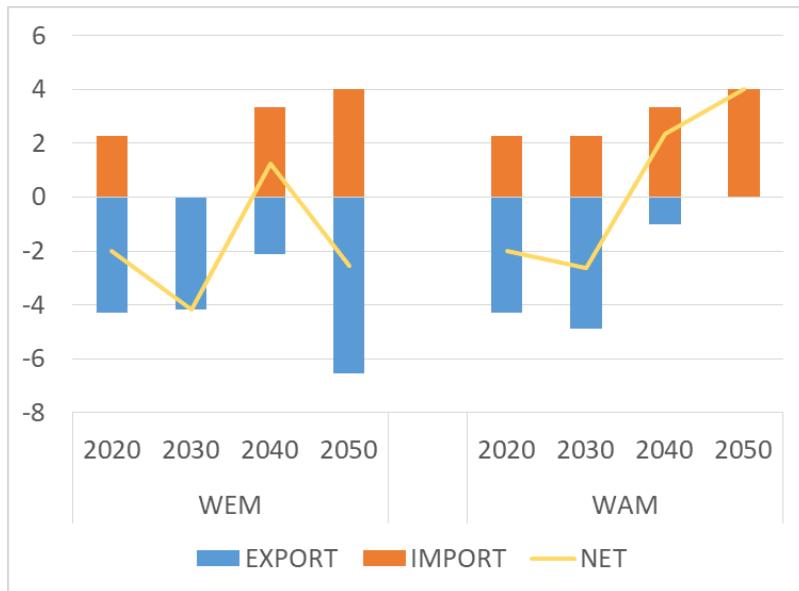
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5.4. The impact of the planned policies and measures described in [section 3](#) on other Member States and regional cooperation at least until the last year of the period covered by the plan, including a comparison with projections based on existing policies and measures

i. Impact on energy systems in neighboring and other Member States in the region, to the extent possible

Figure 5.17 shows that under the WEM scenario, the IPSU will be a net importer of electricity, while under the WAM scenario, the Ukrainian power system will export more electricity to its neighbors.

Figure 5.17: Import-export of electricity from the IPSU to neighboring countries.

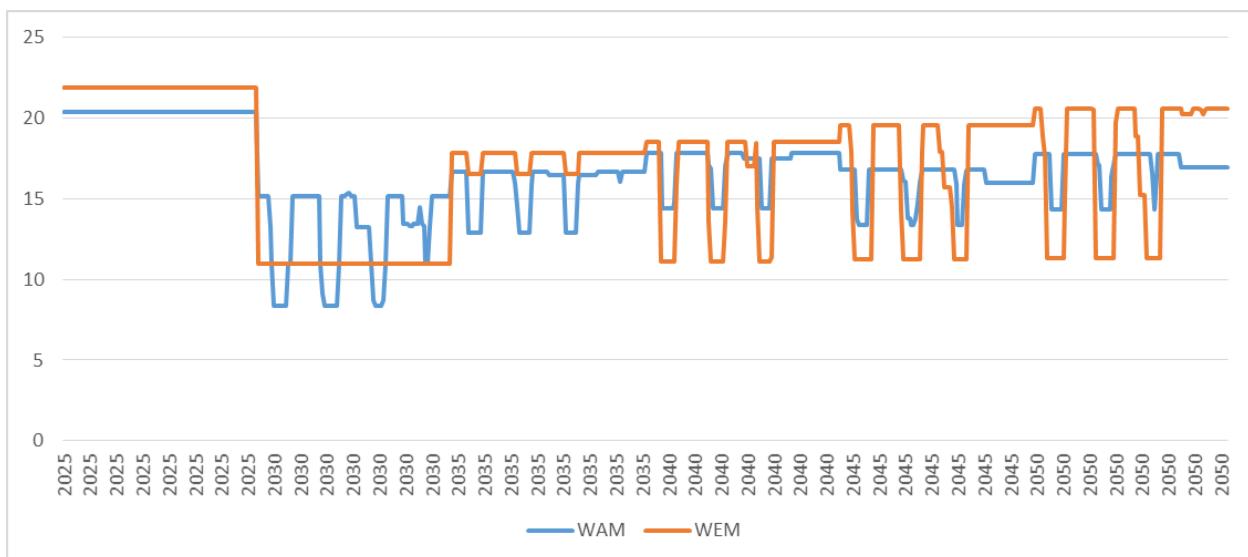


ii. Impact on energy prices, utilities and energy market integration

Electricity market

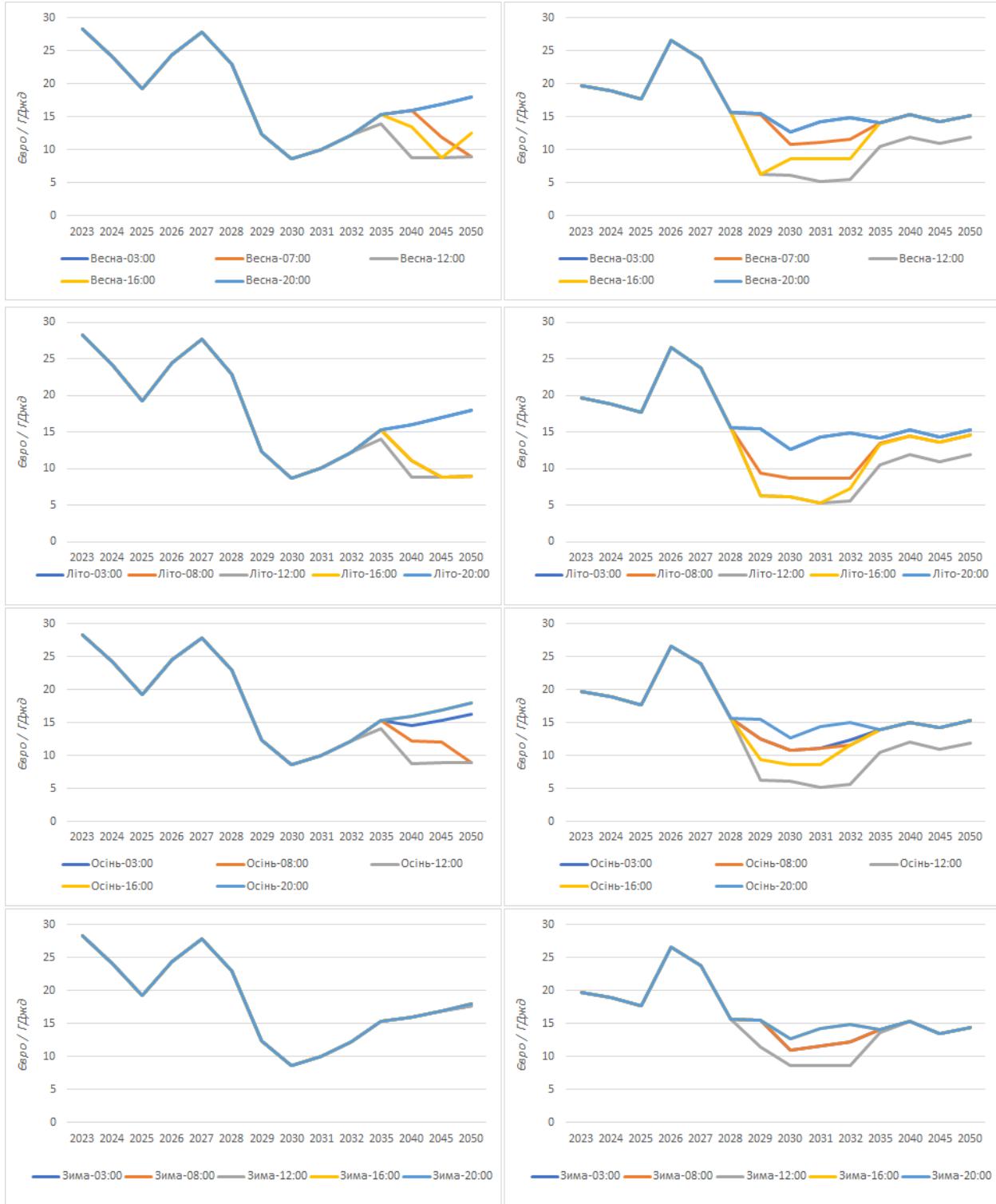
The impact of the planned policies and measures (WAM scenario, Figure 5.18) on energy prices is expected to be quite significant if this scenario is fully implemented. In particular, modeling results using the TIMES-Ukraine model show that average marginal electricity prices may not differ much, but volatility in the WAM scenario is projected to be higher than in the WEM scenario.

Figure 5.18. Marginal electricity price under WEM and WAM scenarios, Euro/GJ



The forecast of marginal prices in selected hours by year for spring, summer, autumn, and winter are shown in Figure 5.19, which shows the advantages of renewable electricity development, especially wind and solar power, compared to coal generation, even in winter.

Figure 5.19. Marginal electricity prices for selected hours in four seasons under WEM and WAM scenarios, Euro/GJ



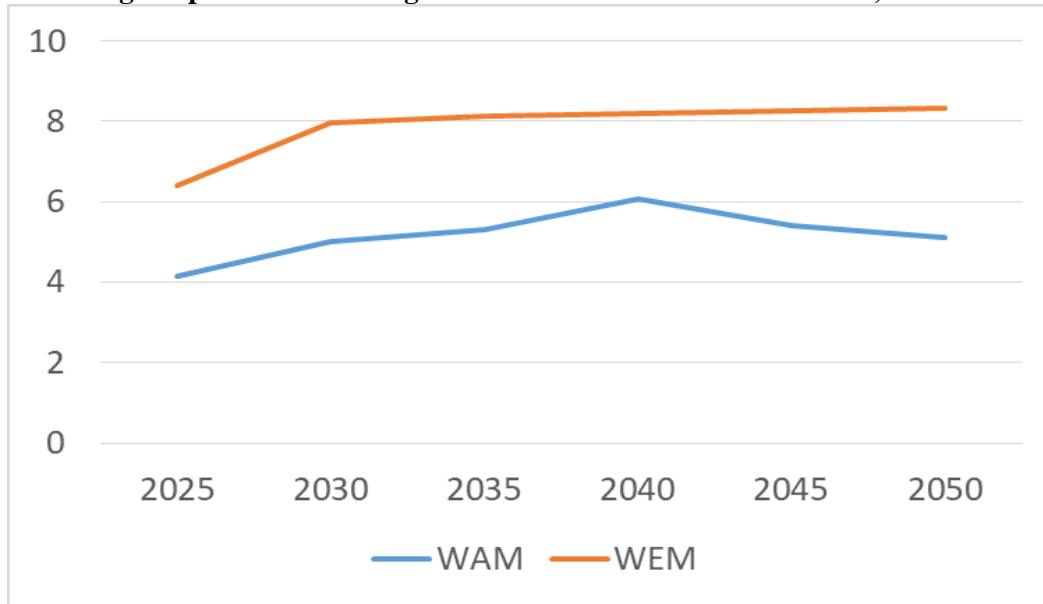
Gas market

The planned policies and measures will ensure conditions for the cross-border movement of gas (natural gas, biomethane) across the border of Ukraine with EU member states and the Energy Community. These include measures to eliminate export bans from Ukraine, create a system of guarantees of origin and sustainability certificates, etc. At the same time, ensuring the unimpeded movement of these goods from Ukraine to the EU and taking into account their real value, including green components, will only be possible if the EU and its member states take the necessary measures.

With the opening of gas exports to the EU, it can be expected that a significant part of domestic production may be exported. This may be positive in terms of foreign exchange earnings and overall business integration, but may carry risks in terms of the need to purchase the required volumes of the resource from abroad (i.e., security of supply and purchase prices). Accordingly, the domestic market should create comfortable conditions for the sale of domestically produced gas within the country. To this end, the planned measures include, on the one hand, liberalization of gas prices (along with updating the system of housing subsidies, creating a system for protecting vulnerable consumers and monitoring and reducing energy poverty), and, on the other hand, improving the conditions for sellers' access to the functioning wholesale market and the retail market (improving the rules of commercial metering, balancing, and reforming the GDS operators).

In addition, the planned policies and measures will enable the existing energy infrastructure to adapt to the new conditions, with a focus on deeper integration into EU policy, research, design, and business processes. This, in turn, will reduce the burden of infrastructure creation and transformation costs on Ukrainian consumers, as well as increase revenues from foreign buyers of energy infrastructure services.

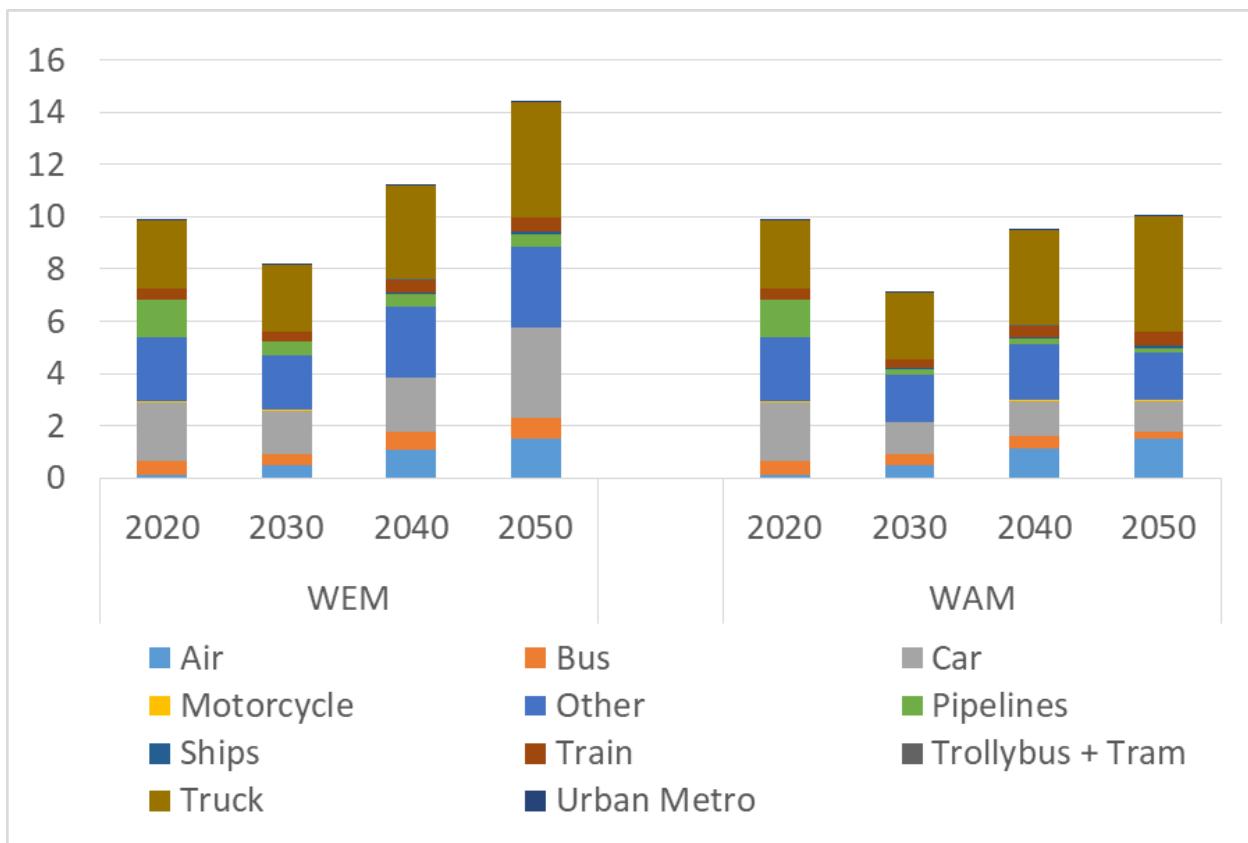
Figure 5.20. Marginal price for natural gas under WEM and WAM scenarios, Euro/GJ



Energy use in transportation

Freight transportation by road is the most energy-intensive mode of transportation in both scenarios. Under WAM, however, at the end of the modeling horizon, it is possible to somewhat decarbonize this mode of transportation with the help of biomethane, bioethanol, and biopropane.

Figure 5.21. Energy consumption in transport by transport mode, million toe



iii. Where applicable, impact on regional cooperation

APPENDICES

Annex 1. Methodological basis for the development of modeling scenarios in accordance with Regulation (EU) 2018/1999 (hereinafter - the Regulation) and taking into account the specifics of public administration in Ukraine

For the purposes of the NEC, modeling is carried out under two mandatory scenarios:

- 1) with existing policies and measures (WEM);⁴⁶⁸
- 2) with planned policies and measures (WAM).⁴⁶⁹

The existing policies and measures include:⁴⁷⁰

- a) implemented policies and measures;
- b) adopted policies and measures.

The Regulation separately defines what is meant by "implemented," "adopted," and "planned" policies and measures. It is useful to review these definitions in both English and Ukrainian:

Regulation 2018/1999⁴⁷¹

'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 mobilized;

'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;

'planned policies and measures' means options that are under discussion and that have a realistic chance of being adopted and implemented after the date of

Regulation 2018/1999 (translation available on the website of the Verkhovna Rada of Ukraine)⁴⁷²

"implemented policies and measures" means policies and measures to which, as of the date of submission of the integrated national energy and climate plan or integrated national energy and climate progress report, one or more of the following conditions apply: there is an existing Union or national law directly applicable, one or more voluntary agreements have been concluded, financial resources have been allocated, human resources have been mobilized;⁴⁷³

"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 integrated national energy and climate progress report, a formal government decision has been made and there is a clear commitment to further implementation;⁴⁷⁴

"Planned policies and measures" means options that are under discussion and have a realistic chance of being adopted and implemented after the date of submission of

⁴⁶⁸ Regulation, Article 8(1).

⁴⁶⁹ Regulation, Article 8(2).

⁴⁷⁰ Regulation, Article 2(2).

⁴⁷¹ <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A02018R1999-20230516>

⁴⁷² https://zakon.rada.gov.ua/laws/show/984_030-18#Text

⁴⁷³ Regulation, Article 2(3).

⁴⁷⁴ Regulation, Article 2(4).

submission of the integrated national energy and climate plan or of the integrated national energy and climate progress report; the integrated national energy and climate plan or integrated national energy and climate progress report;⁴⁷⁵

These definitions will be applied subject to the following.

First, given that integrated national energy and climate progress reports are developed and approved on the basis of an approved NECP,⁴⁷⁶, and that Ukraine's first NECP is currently being prepared, the estimated date of submission of the NECP will be used for the purposes of qualifying measures in accordance with the above definitions. At the same time, based on the terminology of the English version of the Regulation, this 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 Energy Community Secretariat.

Secondly, the phrase "applicable Union [Energy Community] law or national law subject to direct application" should be interpreted taking into account what EU law understands by direct application rules.⁴⁷⁷ Rules of direct application are rules that may serve as a legal basis for claims by individuals and legal entities for the recognition of their rights against both the state (vertical direct application) and other persons (horizontal direct application). A rule of direct application may be contained in a law, a subordinate legislation, or (in some cases) an international treaty. However, not every provision of a law, bylaw or international treaty is a rule of direct application. A rule is directly applicable if it is specific, clear and unconditional, and does not require additional measures of implementation by the state. The status of a rule of direct application is determined by analyzing a particular rule in terms of the above criteria. In the context of Ukraine, an example of a direct application rule is a provision of the law on the principle of non-discrimination in relations between energy market participants. Direct application rules are not rules that define the goals or general tasks of the state, its bodies or other persons, determine a wide range of discretion in their application or require additional implementation actions.

Thirdly, given the relatively small number of direct application provisions in the energy legislation of Ukraine, as well as the legal uncertainty regarding the direct application of the provisions of the Energy Community acts, the implemented policies and measures will primarily include those for which the direct application is not clear:

- a) "one or more voluntary agreements have been concluded" (i.e., the policy or measure is not applied pursuant to a legal provision, but pursuant to a concluded agreement that must be fulfilled), or
- b) "allocated financial resources" (i.e., the relevant costs are included in the tariff of regulated market participants, allocated from the state budget or from international financial assistance, etc.)
- c) mobilized human resources.

With regard to concluded agreements, it is agreements that are taken into account, not memorandums of understanding or intentions.

With regard to the allocation of financial resources, the existence of an approved, sufficiently clear mechanism for financing the relevant policies or measures that can form the basis for the parties' legal claims (e.g., funds are included in the tariff, the right to conclude a green tariff purchase and sale agreement / tax rebate / reduced tax rate is defined by law and there are no regulatory restrictions on its implementation, etc.) Problems with the application of such mechanisms (e.g., non-payment by the parties, accumulation of debts, etc.) may be taken into account for the recognition of the status of policies and measures only in exceptional cases.

⁴⁷⁵ Regulation, Article 2(5).

⁴⁷⁶ Regulation, Article 17(1).

⁴⁷⁷ <https://eur-lex.europa.eu/EN/legal-content/summary/the-direct-effect-of-european-union-law.html>

Implemented policies and measures are closely related to adopted policies and measures, as they are grouped under a single set of existing policies and measures. The criteria for adopted policies and measures are: a) "an official government decision has been made" and b) "there is a clear commitment to further implementation".

Given that the executive branch of government usually adopts specific policies and measures, and the government is its representative, the reference to the existence of a governmental decision does not mean a restriction on the decision-making body (i.e., not only the government can make such a decision), but rather indicates the specificity and feasibility of policies and measures that belong to the group of adopted and, accordingly, existing policies and measures. At the same time, the adoption of a rule by the Parliament on its own initiative (in the absence of the Government's initiative) may be an indicator that a policy or measure cannot be classified as adopted and existing, in particular if the second criterion is not met.

The criterion of a "clear commitment to further implementation" is interpreted as follows: if there is a legal basis for the relevant policy and measure, the necessary actions and resources for its implementation are clearly identified, and there is an understanding that these resources should be allocated. A close link to implemented policies and measures indicates that in the case of adopted policies and measures, it is a clear commitment to allocate financial resources, mobilize human resources, or enter into voluntary agreements.

Fourth, it should be noted that the planned policies and measures refer to "options" (not "policies and measures" as in the previous definitions).

Two criteria are applied to these options: a) being at the stage of discussions; and b) "a real chance of being adopted and implemented after the date of submission". Given the terminology of the English version, discussions do not mean formal public debates, but rather the existence of a discussion of the relevant option in public circles. The existence of a discussion is presumed when it comes to policies and measures that are planned in response to an already adopted act of higher legal force (law).

The second criterion is limiting in terms of the range of all possible options that are discussed. In this case, several cases are taken to 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 they are officially announced by significant state officials (President, Prime Minister, Deputy Prime Minister, Minister, Head or Deputy Heads of the Presidential Office), provided they are sufficiently detailed and objectively realistic. The second case is the existence of specific external factors that clearly prompt the implementation of policies and measures. These external factors may be part of Ukraine's international obligations or contained in the legislation of other countries. It is not enough for such external factors to be part of Ukraine's international obligations to be identified. In addition to formal binding nature, the factor of high risk of sanctions or other negative consequences from failure to fulfill obligations or other external conditions (e.g., failure to provide funds, refusal to purchase products, etc.) should be added. Examples of the second case are the CBA, EU requirements for green hydrogen, sustainability of biofuels, etc.

Fifth, given that the planned policies and measures are options, several such options can be used in the modeling, creating several scenarios with the planned measures. At the same time, section 5 of the NECP should describe the macroeconomic impact, if possible, the impact in terms of health, environment, labor requirements and social impact, the ability to attract financing 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 a proper and comprehensive analysis of such options.

It should be noted that policies/measures are considered to be policies/measures adopted at the state level. For the purposes of the first NECP of Ukraine, policies/measures at the level of companies, including state-owned ones, are not distinguished as separate policies/measures, but are adopted to determine the extent to which the goals of state policies/measures are achieved.

The TIMES-Ukraine model developed at the State Institution "Institute for Economics and Forecasting of the National Academy of Sciences of Ukraine", improved and updated to the latest software in July 2023

thanks to the global Net Zero World initiative, is used to model the NEC scenarios. The applied model covers the Energy and Industrial Processes and Product Use sectors (as defined by the Intergovernmental Panel on Climate Change, IPCC). For the remaining sectors (Agriculture, LULUCF, Waste), other modeling tools will be used.

Modeling for the purposes of the NECP is carried out to assess the extent to which existing and planned policies and measures allow achieving the goals set at the EU or Energy Community level. However, due to the lack of time for the preparation of the first NECP of Ukraine, the impact of individual existing and planned measures is not investigated, but the assumption is made that those measures identified as existing or planned are sufficiently realistic and effective to achieve the full or expertly determined impact envisaged by their developers. Modeling for NECP purposes differs from other approaches, such as goal-based modeling, in which a specific goal is set as an assumption and the purpose of the modeling is to determine the optimal way to achieve the fixed goal.

The modeling process for the purposes of the NERC consists of several stages:

- 1) formulation of a number of assumptions common to all NEC scenarios, in particular, regarding key macroeconomic indicators, future demographics, prices on foreign markets, cost of technologies, residential and non-residential areas, and minimum or threshold values of certain energy indicators;
- 2) allocation of all policies and measures described in the NECP to scenarios, as well as to scenario parameters and indicators; the main criteria for allocation to parameters and indicators are: a) parameters have a higher probability of occurrence of impacts that can be included in the NECP; b) parameters do not compete with other policies and measures within the same scenario;
- 3) creating scenarios as a combination of assumptions and selected parameters;
- 4) obtaining the first modeling results;
- 5) review 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 evaluation, and adjusting scenarios and, if necessary, goals, policies and measures to re-model and update the NECP narrative.

Annex 2. Assumptions about the main parameters of agricultural development

Category.	Units of measurement	ONVO	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 households	thousand heads		1 671,49	1 872,07	2 059,28	2 162,24
Cows in households	thousand heads		1 127,79	1 263,12	1 389,43	1 458,90
Total sheep in Ukraine	thousand heads		770,920	801,757	841,845	858,682
Ewe lambs and ewes 1 year and older in farms of all forms of ownership	thousand heads		524,790	545,781	573,070	584,532
Total 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 sows in agricultural enterprises	thousand heads		220,42	242,46	254,58	264,76
Piglets from 2 to 4 months old 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 households	thousand heads		2 024,41	2 267,34	2 221,99	2 088,67
Main sows in households	thousand heads		118,29	132,48	129,83	122,04
Piglets from 2 to 4 months old in households	thousand heads		445,37	498,81	488,84	459,51

Pigs for fattening in households	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 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 rabbits in Ukraine	thousand heads		4 551,996	4 734,08	4 686,73	4 639,87
Total 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 households	thousand heads		87 091,530	95 800,68	94 842,68	93 894,25
Chickens and roosters in households	thousand heads		72 488,059	79 736,86	78 939,50	78 150,10
Geese in households	thousand heads		3 563,229	3 812,65	3 774,53	3 736,78
Ducks in households	thousand heads		9 818,918	10 604,43	10 498,39	10 393,40
Turkeys in households	thousand heads		801,279	821,31	813,10	804,97
Milk yield from one cow in agricultural enterprises	kg/day head		17,32	17,50	18,00	18,20
Milk yield from one cow in households	kg/day head		12,89	13,00	13,30	13,40

The amount of milk produced per ewe per year in farms of all forms of ownership	kg/year per head		135,5	139,0	141,0	143,0
Average shearing per head in all categories of farms	kg/year		3,04	3,09	3,17	3,20
<i>Expert data for field crops (without rice) were entered</i>	kg N/year		1 365 545 488,14	1 800 000 000,00	2 200 000 000,00	2 500 000 000,00
Listed under rice <i>expert data</i>	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	698 423,3	733 344,5	770 011,7
Annual amount of limestone flour applied	t		294 000,00	308 700	324 135	340 341,7
Total harvested area in Ukraine	thousand hectares	29245	25 693,06	30 323,63	31 839,81	33 431,81
<i>cereals</i>	thousand hectares		12 973,38	16 255,11	17 067,86	17 921,26
winter wheat	thousand hectares		5 824,03	7 264,22	7 627,44	8 008,81
spring wheat	thousand hectares		220,90	189,30	198,76	208,70
corn for grain	thousand hectares		4 410,92	5 510,90	5 786,44	6 075,77
winter barley	thousand hectares		949,02	1 250,77	1 313,31	1 378,98
spring barley	thousand hectares		1 089,78	1 424,84	1 496,08	1 570,89
winter rye	thousand hectares		102,59	172,09	180,70	189,73
spring rye	thousand hectares		1,30	1,00	1,05	1,10
winter triticale	thousand hectares		7,30	8,20	8,61	9,04
spring triticale	thousand hectares		0,40	1,00	1,05	1,10
oats	thousand hectares		162,92	186,23	195,54	205,32
buckwheat	thousand hectares		121,80	93,27	97,93	102,83

sorghum	thousand hectares		21,17	47,60	49,98	52,48
millet	thousand hectares		56,57	91,50	96,08	100,88
rice	thousand hectares		1,40	10,10	10,61	11,14
other cereals, hybrids, mixtures of cereals	thousand hectares		3,30	4,08	4,28	4,50
<i>legumes</i>	thousand hectares		210,55	340,79	357,83	375,72
beans	thousand hectares		38,47	48,66	51,10	53,65
horse beans	thousand hectares		2,30	1,90	2,00	2,09
chickpeas	thousand hectares		3,10	8,40	8,82	9,26
lentils	thousand hectares		3,00	5,40	5,67	5,95
peas	thousand hectares		149,69	258,73	271,66	285,25
winter vetch	thousand hectares		0,10	0,40	0,42	0,44
vika jara	thousand hectares		1,70	2,70	2,84	2,98
sweet lupine	thousand hectares		1,30	3,40	3,57	3,75
bitter lupine	thousand hectares		0,10	0,30	0,32	0,33
other leguminous crops	thousand hectares		10,80	10,90	11,44	12,01
<i>technical</i>	thousand hectares		8 817,32	9 541,45	10 018,52	10 519,45
soybean	thousand hectares		1 571,17	1 335,17	1 401,92	1 472,02
peanut	thousand hectares		0,03	0,05	0,05	0,06
flaxseed (oilseed)	thousand hectares		46,02	39,17	41,13	43,18
long flax (for seeds)	thousand hectares		0,00	0,10	0,11	0,11
mustard	thousand hectares		25,43	27,22	28,59	30,02
winter rape	thousand hectares		1 194,97	979,36	1 028,33	1 079,74
kohlseed (spring rape)	thousand hectares		24,60	32,70	34,34	36,05
sesame seeds	thousand hectares		0,00	0,00	0,00	0,00

sunflower	thousand hectares		5 750,42	6 871,35	7 214,92	7 575,67
castor oil	thousand hectares		0,00	0,00	0,00	0,00
red	thousand hectares		0,10	0,00	0,00	0,00
oil poppy	thousand hectares		0,00	2,00	2,10	2,21
Central and southern hemp (for seeds)	thousand hectares		0,20	1,70	1,79	1,87
pumpkins (seeds)	thousand hectares		5,10	7,50	7,88	8,27
oilseeds other	thousand hectares		1,57	1,05	1,10	1,16
cotton	thousand hectares		0,00	0,00	0,00	0,00
Jute, kenaf and bast fibers other	thousand hectares		0,00	0,00	0,00	0,00
flax straw	thousand hectares		0,00	0,40	0,42	0,44
hemp straw	thousand hectares		0,80	0,30	0,32	0,33
other spinning crops	thousand hectares		0,00	0,00	0,00	0,00
factory sugar beet	thousand hectares		184,29	226,70	238,03	249,93
uterine sugar beet	thousand hectares		0,00	0,03	0,03	0,03
sugar beet seeds	thousand hectares		0,52	0,55	0,58	0,61
sugar cane	thousand hectares		0,00	0,00	0,00	0,00
spices	thousand hectares		0,60	3,20	3,36	3,53
essential oil crops	thousand hectares		3,90	7,00	7,35	7,72
medicinal plants	thousand hectares		1,80	3,80	3,99	4,19
plants used mainly in perfumery, pharmaceuticals, or as insecticides, fungicides, etc.	thousand hectares		0,00	0,00	0,00	0,00
tobacco	thousand hectares		0,90	1,00	1,05	1,10
terry	thousand hectares		0,00	0,00	0,00	0,00

chicory	thousand hectares		2,40	0,00	0,00	0,00
energy plants	thousand hectares		2,50	1,10	1,16	1,21
technical crops other	thousand hectares		0,00	0,00	0,00	0,00
<i>Root and tuber crops, vegetable and melon crops for open field food production</i>	thousand hectares		1 748,32	1 864,39	1 957,61	2 055,49
potato	thousand hectares		1 282,07	1 313,99	1 379,68	1 448,67
sweet potato	thousand hectares		0,00	0,00	0,00	0,00
cassava	thousand hectares		0,00	0,00	0,00	0,00
edible roots and tubers with a high content of starch and inulin others	thousand hectares		0,00	0,00	0,00	0,00
open and closed ground vegetable crops in total	thousand hectares		424,30	485,75	510,03	535,54
vegetable root crops and uterine crops	thousand hectares		0,00	0,00	0,00	0,00
food melons and gourds	thousand hectares		41,34	64,15	67,35	70,72
seeds of annual vegetable crops	thousand hectares		0,11	0,21	0,22	0,23
seeds of biennial vegetable crops	thousand hectares		0,10	0,10	0,11	0,11
seeds of perennial vegetable crops	thousand hectares		0,10	0,10	0,11	0,11
seeds of food melons and gourds	thousand hectares		0,30	0,10	0,11	0,11
<i>stern</i>	thousand hectares		1 943,48	2 321,90	2 438,00	2 559,90
fodder roots	thousand hectares		166,80	177,23	186,10	195,40
fodder sugar beet	thousand hectares		0,60	0,80	0,84	0,88
fodder beet (chard),rutabaga	thousand hectares		0,00	0,00	0,00	0,00
other fodder roots	thousand hectares		0,00	0,00	0,00	0,00

fodder melons and gourds	thousand hectares		41,39	51,29	53,85	56,55
fodder corn	thousand hectares		204,71	220,92	231,97	243,57
annual grasses for hay	thousand hectares		154,53	201,13	211,19	221,75
annual grasses for green fodder, haylage, silage, grass flour	thousand hectares		56,10	94,63	99,36	104,33
perennial grasses for hay	thousand hectares		648,80	708,33	743,74	780,93
perennial grasses for green fodder, haylage, silage, grass meal + perennial grasses for grazing	thousand hectares		113,66	140,74	147,77	155,16
hayfields for hay	thousand hectares		536,67	695,46	730,24	766,75
hayfields for green fodder, haylage, silage, grass flour	thousand hectares		5,88	6,78	7,12	7,47
pastures cultivated for hay	thousand hectares		3,80	5,80	6,09	6,39
Pastures cultivated for green fodder, haylage, silage, grass meal	thousand hectares		4,67	8,37	8,79	9,23
other fodder crops	thousand hectares		1,41	1,41	1,49	1,56
fodder beet seeds	thousand hectares		0,09	0,19	0,20	0,21
seeds of fodder melons and gourds	thousand hectares		0,00	0,40	0,42	0,44
seeds of annual herbs	thousand hectares		0,20	2,00	2,10	2,21
seeds of perennial herbs	thousand hectares		4,16	6,31	6,63	6,96
seeds of other fodder crops	thousand hectares		0,00	0,10	0,11	0,11
fodder uterine roots	thousand hectares		0,00	0,00	0,00	0,00
Organic farming	thousand hectares	1000	264*	1 240**	1 310	1 365
Low till and no till technologies	thousand hectares	2200		3 500***	3 675	3 858,75
Yield increase	%	10% from 2016-2019		State Statistics Service	5% of the figures for 2030	5% of the figures for 2040

				data for - 2021		
Annual area of arable/drained organic soils (water agency data)	ha		471 602,000	471 602,000	470,000	470,000
Utilization of manure for biogas	t (16%)	16				

Notes:

*Data provided by the Ministry of Agrarian Policy to the State Statistics Service.

**The indicator is envisaged by the National Economic Strategy for the period up to 2030, approved by the Resolution of the Cabinet of Ministers of Ukraine No. 179 dated 03.03.2021

*** Taken from the table indicator Forecast (possible targets) of GERD (data of the Ministry of Economy 2030).

Annex 3. Methodology for forecasting greenhouse gas emissions in the solid waste management sector

GHG emissions in the waste management sector were estimated in accordance with the principles and methodologies of the 2006 IPCC Guidelines for National Gas Inventories⁴⁷⁸ (hereinafter - 2006 IPCC Guidelines), so the sources of GHG emissions do not correspond to economic activities, but to the categories recommended in the above methodologies (IPCC categories) in the Waste sector. Accordingly, emissions from agricultural residues management, as well as relevant GHG emission reduction policies, were accounted for either in the LULUCF sector or in the energy sector, if such policies were accompanied by useful energy production. GHG emissions that are accompanied by beneficial energy use during waste treatment, such as landfill gas and wastewater methane recovery, as well as energy production from waste incinerators and waste incineration in cement production, were accounted for in the Energy sector, but the effect of GHG emission reductions resulting from these activities was accounted for in the Waste Management sector. GHG emissions in the Waste sector were estimated in strict accordance with the methods and emission factors used for reporting national GHG emissions to⁴⁷⁹ as part of Ukraine's obligations under the UN Climate Change Convention and the Paris Agreement. For example, methane emissions from solid waste disposal at landfills and dumpsites were estimated using the first-order attenuation method, as recommended in the 2006 IPCC Guidelines.

General assumptions and methodological framework for determining data on activities in the Waste sector. The following indicators and trends were used in the modeling of the Waste sector by category, with sector-specific indicators in italics:

Solid waste disposal: population, *specific volumes of solid waste (municipal solid waste) per capita, waste management practices (share of landfilling, reuse, recycling, composting, incineration), coverage of the population by centralized waste collection, construction of new sanitary (deep managed) landfills, composition of solid waste, share of flaring and landfill gas recovery.*

To ensure the principle of transparency, the MSW mass balance model used in modeling GHG emissions in the Waste sector is shown in Fig. D2.1, from which the following basic provisions of mathematical modeling follow:

1. The total amount of solid waste generated corresponds to the sum of officially and unauthoritatively disposed of solid waste⁴⁸⁰. The initial data for estimating the volume of solid waste generation are: population, coverage of the population by the centralized waste collection system, and specific volumes of solid waste generation per capita.
2. After estimating the volume of MSW generation, these volumes are divided into separate streams of MSW components, the size of which is determined based on their component (morphological) composition. These streams are: paper and cardboard, food waste, gardening waste, wood, personal care products, rubber and leather, textiles, and non-biodegradable components (including ferrous metals, non-ferrous metals, glass, plastic, hazardous and other inorganic). At the same time, solid waste that is not covered by the centralized collection system is disposed of in unmanaged shallow landfills.

⁴⁷⁸ <https://www.ipcc-nggip.iges.or.jp/public/2006gl/>

⁴⁷⁹ <https://unfccc.int/documents/628276#main-content>

⁴⁸⁰ Unspecified practices (e.g., yard composting, gray recycling, etc.) for MSW management that are not covered by the centralized collection system are excluded from the mass balance because they do not result in significant GHG emissions.

3. Food and gardening components in the mixed MSW stream form a composting stream (biological treatment), the volume of which is determined by the total composting share.
4. Glass forms a recyclable stream, the volume of which is determined by the proportion of recycling.
5. Paper, cardboard, and non-biodegradable components (including plastics and metals) form the recyclable stream, the volume of which is determined by the total recycling rate.
6. The remaining part (residual) of MSW is divided into two streams: incineration and disposal, which in turn are determined by the share of incineration.
7. The distribution by type of disposal sites is determined by the construction of new sanitary landfills.

Biological treatment (composting) of solid waste: population, industrial and agricultural sector development indicators, *specific volumes of solid waste generation per capita, share of composting and composting technologies.*

Incineration and open burning of waste: GDP growth, industrial sector development indicator, *category-specific legislation (ban on incineration of solid waste without energy use).*

Wastewater treatment and discharge: population, share of urban and rural population, indicators of sector development (energy, ferrous metallurgy, agriculture, food industry, etc.), *share of treatment and discharge; consumption of meat, dairy products and fruits per capita, technology development, share of flaring and methane recovery from wastewater treatment.*

Fig. D2.1. General scheme of the MSW mass balance model (mass flows)

