

UKRAINE 2050 GREEN ENERGY TRANSITION CONCEPT

— UKRAINE GREEN DEAL —



PREAMBLE

Ukraine's 2050 Green Energy Transition Concept was developed as a response to significant transformation of approaches to energy development around the globe. The Paris Agreement outlines new international commitments to support stronger climate action. These changes directly affect Ukraine's partner countries, specifically European Union member states, which are now formulating an updated joint climate and energy policy.

European Commission President Ursula von der Leyen has declared a strategic goal of making the EU climate neutral by 2050 under the European Green Deal, seeking faster energy transition influencing all branches of the economy and cooperation with countries outside the bloc. This transition is both a challenge and an opportunity for Ukraine, a country with an extremely ambitious EU Association Agreement and cooperation as part of the Energy Community.

Successful adaptation of Ukraine's climate and energy policy will produce a positive feedback loop, driving sustainable development and competitiveness for our country.

This is why Ukraine's National Security and Defence Council resolved that the country needs to revise its 2035 Energy Strategy and develop this new Concept.



PRAGMATIC APPROACH

The Concept's defining feature is that it is predicated on multi-factor economic and mathematical modelling of Ukraine's energy development scenarios until 2050, targeting Ukraine's second Nationally Determined Contribution (NDC) under the Paris Agreement.

This approach is underpinned by the best global practices of preparing strategic energy planning documents, specifically those used by the International Energy Agency (IEA) and other international organisations as well as the EU.

We propose a new approach to strategic planning: the key goal will be to reduce greenhouse gas (GHG) emissions, thus ensuring a transition of the Ukrainian economy to climate neutrality by 2070 in a socially positive way. The intermediate objective during this transition will be to cut greenhouse gas emissions by 2030 to a level that will be set in Ukraine's second Nationally Determined Contribution in line with the requirements of the Paris Agreement, which in turn will meet the findings of the Special Report on Global Warming published by the Intergovernmental Panel on Climate Change (IPCC) highlighting the implications of the average global temperature rising by 1.5°C.

The Concept is a dynamic document and will be updated to account for future trends and changes in the global climate, environmental and energy policy, technology development, management techniques and knowledge. The Concept's implementation during the next decade will follow the 2030 Integrated Climate Change and Energy Development Plan.

1. BACKGROUND - THE NEED FOR ENERGY TRANSITION

Combating climate change is a global challenge requiring broad international cooperation. This consensus was reflected in a set of sequential international agreements: the UN Framework Convention of Climate Change (UNFCCC), the Kyoto Protocol, and the Paris Agreement. Ukraine remains an active participant in combating climate change on an international scale and ratified all the specified agreements.

Ukraine became one of the first European countries to ratify the Paris Agreement (on 14 July 2016), which can be partially explained by the issues of significant climate changes in the territory of Ukraine linked to environmental, economic and energy challenges.

The key negative consequences of climate change in Ukraine are: higher risks for human health related to almost every manifestation of hydrometeorological abnormalities; potential significant reduction of key agricultural crops' yields; aggravation of issues related to water supply not limited to just southern and south-eastern regions; intensified degradation of lands and desertification; reduced productivity, sustainability and resistance of forests; accelerated degradation of ecosystems; accidents and unstable operation of electric networks and centralised heat supply systems, other infrastructure facilities etc.

Back in November 2018, the European Commission presented a long-term strategic concept to reduce greenhouse gas emissions, thus demonstrating how Europe may pave the path towards climate neutrality with net-zero greenhouse gas emissions to be in place by 2050. This strategy includes seven key components: maximisation of energy efficiency; maximum deployment of renewable energy sources and electrification; transition to green transport; development of smart grids and utilities; expansion of bio-energetics and natural carbon sequestration; sequestration of remaining CO₂ emissions through technologies on carbon capture and storage.

Continuing to be an active participant to combating and adapting to climate change on a global scale, acknowledging its responsibility for achievement of the Paris Agreement goals and acting in line with national interests and priorities, the Government of Ukraine proposes a Concept based upon modern global scientific knowledge and practices providing for such a reduction of greenhouse gas emissions so that the climate neutral economy may be transitioned to in the second half of this century on a fairness basis and in terms of sustainable development and efforts aimed at eradication of poverty as required by Article 4 of the Paris Agreement.

Energy efficiency and developing renewable energy sources are crucial areas of Ukraine's energy transition. Substantial progress in the improvement of energy use will significantly decrease the demand for production of additional energy resources required for projected GDP growth and improved well-being of citizens. Meanwhile, the very structure of the required energy resources will be subject to significant changes primarily caused by advancing electrification of the economy (transport, industry, buildings), which will require a considerable increase in the share of renewable energy sources in electricity production and a relevant drop in the utilisation of fossil fuels.

In return, the green energy transition will assist in achieving the following key goals:

- 1** Ukraine as an energy independent country is resistant to security challenges
- 2** Electricity production and consumption in Ukraine are sustainable
- 3** Ukraine to be a climate neutral economy by 2070

Energy transition is considered crucial for the growth of the Ukrainian economy, improvement of social standards, creating new opportunities for youths, increasing competitiveness of Ukrainian companies and domestic production, and promoting Ukraine in global ratings of freedom and business.

2. KEY TRENDS IN DECARBONISATION OF THE ECONOMY

2.1. Energy efficiency and energy conservation

Energy efficiency and energy conservation are key priorities in the energy policies of many countries. Improvements in energy efficiency help reduce consumption of resources while ensuring economic growth and satisfying citizens' needs as well as resulting in enhanced competitiveness of the national economy.

Ukraine's GDP to energy and carbon consumption ratios are still extremely high compared to not only those of Organisation for Economic Cooperation and Development members (by approximately 3x) but also Eastern European neighbouring countries.

Energy efficiency and prudent use of resources is one of the key areas of Ukraine's green energy transition and remains a key priority for the Government. For achievement of this priority it is necessary to implement policies aimed at improving the efficiency of energy resource utilisation and energy saving while improving the quality of energy services and supply of energy resources. The primary focus is to be on the residential building sector as it has the highest potential for energy efficiency improvement.

The government should make every effort to reduce the primary energy intensity of Ukraine's GDP to the average EU level as quickly as possible and set an example of fast energy efficiency enhancement and prudent use of resources, in particular, through large-scale thermal renovation of public buildings and public tenders based on mandatory energy efficiency and environment criteria.

2.2. Renewable energy sources

Renewable energy, together with energy efficiency, form the most powerful tools in decarbonisation of national and global economies.

Ukraine possesses considerable natural potential to make the green energy transition across many industries. Taking into account the capabilities and availability of cutting-

edge renewable energy technologies and their rapid development, it is feasible for Ukraine to reach a 70% share of renewable energy sources in its generation mix by 2050. A considerable part of that (up to 15%) is to be energy generation by roof-top solar panels on households and businesses.

The role of decentralised power supply is expected to grow, which requires application of new technologies relating to consumption management, distributed storage and distributed generation.



2.3. Waste handling

It is necessary to create conditions to improve living standards using a systemic approach to waste management at the country-wide and local levels, namely:

- waste avoidance, recycling, disposal, processing and implementation of new technologies of waste management.
- transition to a recycling economy in which products, raw materials and resources are used as long as possible and waste creation is lessened.
- implementation of extended producer and importer responsibilities for acceptance of returned products and waste after their usage and also further waste management;
- implementation of a self-sufficiency approach envisaging creation of an integrated network of waste management facilities that enables a state or region to manage and dispose of their own waste independently.



2.4. Innovative agriculture and forestry

The agricultural sector's share in the energy consumption mix is moderate and the sector has significant potential for energy efficiency enhancement and transition to renewable energy. To unlock this potential it is necessary to:

- improve the energy and resource efficiency of agricultural products and food production;
- eliminate consumption of carbon intensive sources and maximise usage of renewable energy sources to reach full energy self-sufficiency;
- increase sustainable production of biomass, biofuel and other renewable sources to support green energy transition in other industries.
- Forestry plays a key part in non-technological greenhouse gas sequestration. Thus, the state as the key forestry land owner can increase the net potential capture and storage of greenhouse gases by:
 - increasing the area covered by forests and woodlands, planting new forests;
 - sustainable forest management taking into account change in line with the Climate Smart Forestry concept, increasing the resistance and productivity of forests;

- lessening deforestation, timely forest restoration, rational arrangement of forests and plants, stimulating tree planting activities in residential areas.



2.5. Digitalisation of economic processes

Digitalisation is transforming economic relations, which leads to a significant reduction in the turnover of natural and technical resources and the amount of their physical relocations. It speeds up economic and administrative processes, makes it possible to provide services remotely, facilitates governance, and optimises migration of people and use of transport. These effects will help us build a resource- and energy-efficient climate neutral economy.

Decarbonisation of the energy sector will involve its decentralisation and development of distributed generation, leading to a rapid increase in the number of energy facilities and links and more complicated energy systems. In order to operate such systems, we will need to build a fundamentally different technology platform and smart grids based on digital technology as well as information and communication systems. Digitalisation of electric networks will pave the way for wider and more reliable use of renewable energy facilities and energy storage technologies and help us apply dynamic pricing as well as get consumers involved in demand-side management and remote and smart energy consumption management.



3. ENERGY SECTOR DECARBONISATION



3.1. Production and supply of energy resources

A change in the structure of the Ukrainian economy has to provide a gradual green transition and reduction of the mining industry and exports.

More intensive usage of renewables will cause a reduction of the need for traditional fossil fuels and drawdown of certain mining industries, first of all, in the coal sector.

Decarbonisation in mining and supply of energy resources will facilitate loss reduction during the course of natural gas, electricity and heat transportation, which will demand substantial modernisation of main and distributional networks, energy supply decentralisation, etc.



3.2. Electricity

There has to be parallel processes of modernisation, reduction of greenhouse gas emissions and gradual decrease in coal-fired generation.

Complete substitution of coal-fired thermal power plants (TPPs) until 2050 will proceed due to development of the solar and wind generation, biomass power plants, together with highly manoeuvrable gas-firing generation capacities (in a remoter prospect, firing of synthetic gas produced by renewables), energy accumulation and storage technologies for balancing in the energy system and, possibly, new nuclear energy technologies.

It is anticipated an increase in the cogeneration share and, where it will be economically reasonable, carbon capture and storage technologies may be used in the firing plants.

Nuclear generation's share in the electricity balance of Ukraine will decrease to 20-25% and hydro energy will remain at the current level. New nuclear capacities can be built based on small module nuclear reactor technologies. In such case, green energy import should not have great significance in balancing of the United Energy System of Ukraine.



3.3. Heat supply

It is considered reasonable to ensure expansion of highly efficient cogeneration and trigeneration in the heat supply sector.

New cogeneration plants for central heating have, first of all, to be directed to utilisation of biomass and biogas.

In local and house boilers it is reasonable to implement heat transition to biomass at the level of municipal heat supply systems – transition to decentralised systems with free access of producers to the networks and envisage a possibility of the heating systems electrification. In such case, it is important to encourage implementation of new geothermal energy technologies and thermal pumps.



3.4. Markets and infrastructure

In order to ensure green energy transition it is necessary to build modern energy markets with a high level of openness and competition, which will incite players to optimise costs and prices, and consumers to rationalise energy consumption. In such case, the role of consumers has to change towards being active market players for energy output and balancing service provision.

A significant factor in competition development has to be integration of the energy markets of Ukraine with European counterparts and boosting trade of energy efficient assets and services as well as an increase in the share of international players in the national energy market. In such case, it is important to ensure free, non-discriminative and transparent access of third parties to energy infrastructure (electricity, gas and heat supply networks), which has to be significantly modernised.



3.5. Price affordability of energy services

Transition to a climate neutral economy will be accompanied with large-scale investments and expenditures in energy and consumption sectors directed to implementation of new technologies for energy production, transportation and consumption. Therefore, it is important to develop not only an environmentally and climatically friendly energy sector but also one that is economically sustainable in order to avoid any consumer price shock, social, economic or political resistance, and to provide social support for the green energy transition.

A main compensator for possible electricity price growth may be broad implementation of modern intelligent metering systems, energy efficient consumption, flexible price systems and consumer demand management.

4. DECARBONISATION OF RESIDENTIAL AND NON-RESIDENTIAL BUILDINGS

The consumption of energy resources by residential and non-residential buildings in Ukraine is about 40% of all energy consumed in the country, and the amount of energy consumed per square meter is several times higher than the corresponding figure in EU countries with similar climatic conditions.

To implement the green energy transition of Ukraine by 2050, it is necessary to:

- carry out a large-scale thermal renovation of buildings to bring energy consumption per square meter to the EU average level;
- construct new energy-efficient buildings, passive houses;
- introduce a national system of technical regulation on green building;
- increase the efficiency of individual heating and cooling of buildings by replacing carbon-intensive energy resources (coal, gas) with clean energy - electricity and heat from renewable sources (solar, geothermal energy, biofuels);
- develop district heating, cooling and hot water systems, especially in big cities, on the basis of renewable energy sources;
- implement energy storage technologies at the household level;
- continuously inform and educate people and businesses about the advantages of implementing energy efficiency measures.

Particular importance will be given to energy cooperatives, such as those of EU countries, which should become important players in local energy markets, intensifying competition and development of a decentralised energy sector based on renewable sources and focused on local energy resources.

5. LOW-CARBON AND RESOURCE-EFFICIENT INDUSTRY

The energy intensity of the GDP of Ukraine's industrial sector is more than four times higher than the average EU level, so the competitiveness of domestic goods is much lower compared to that of EU ones. One of the goals of the Concept is to reduce the energy intensity of Ukraine's GDP to the EU average.

In Ukraine, industry accounts for approximately 30% of total energy consumption. More than half of energy is consumed by ferrous metallurgy. To address this pressing issue as part

of the implementation of the green energy transition, it is necessary to:

- bring down the energy intensity of domestic industrial production to the level of economically developed countries through advanced and innovative energy efficient technologies, including the electrification of industrial processes;
- reuse (recover) heat generated during industrial processes as efficiently as possible;
- implement energy storage technologies at industry level;
- intensify use of renewable energy sources (biofuels and waste, electricity and heat from renewables) in industrial processes to replace carbon-intensive resources;
- increase industrial production and use of hydrogen and other synthetic energy resources produced from renewables;
- introduce circular economy practices to significantly improve the resource efficiency of industrial production.

6. ECO-FRIENDLY TRANSPORT

Transport is a major energy consumer in Ukraine. In 2017, transport (including pipelines) accounted for over 20% of energy consumption. A majority of the fuel used in the transport sector is oil products (diesel fuel and petroleum) and natural gas.

The following measures are required for decarbonisation and greening of transport:

- full renovation of the transportation fleet, involving replacement of ICE-driven cars with electric-, hydrogen- and fuel cell-powered vehicles or other means of transport meeting sustainability and eco-friendliness criteria;
- optimisation of passenger and cargo traffic by increasing the share of passengers carried by public transport and the share of cargo transported by railway;
- better planning of the transportation network and public transport routes, increased usage of eco-friendly transport and micromobility in cities;
- implementation of multimodal cargo transportation technologies;
- retrofitting and building more water and river ports;
- implementation of energy conservation across the process chain.

7. RESEARCH AND INNOVATION

7.1. Boosting climate research

It makes sense to develop Ukrainian climate research in the context of participation in international studies (integration in current research projects, creation of consortia) carried out under the aegis of economically developed countries (e.g., EU Horizon 2020, programmes launched by the USA, Japan etc.), interstate projects etc.

We need to ensure interaction between Ukrainian scientists and leading scientific institutions worldwide.

Scientific studies aimed at finding ways to combat and adapt to climate change will be made a priority and receive adequate support from the Government.

7.2. Comprehensive support for innovation, startups, pilot projects

Innovations, startups, and pilot projects need to be financed using both private and state-budget funds to support projects/startups at different stages (with different risk levels).

State support of innovations and startups needs to aim at creating jobs in Ukraine's "green" circular economy, ensuring uniform regional distribution.

State financing of studies and innovation has to be based on competitive principles, and the amount of support should grow in order to reach at least 3% of GDP as quickly as possible. To this end, special programmes of the Ukrainian Startup Fund and a special-purpose national fund for support of scientific projects with an independent supervisory body will be created. Special priority will be given to young researchers and scientists.

7.3. Strengthening and intensification of cooperation between science and business

As shown by the best European practices, the transition to a climate-neutral economy will require systemic integration of education, science and business. Such integration is of critical importance to ensure sustainable availability of personnel, financing and technological support to innovation in the energy sector and power engineering and will give rise to innovation and production clusters and improve employment rates, especially among young people.

Cooperation between business and research institutions will be stimulated by both changing public private partnership mechanisms and pursuing higher education reform as universities will become the main research centres.

8. INVESTMENT AND FINANCING

8.1. Cost of transition

The Government will secure a beneficial investment climate for the green energy transition to encourage businesses and households to invest in climate-friendly technology and infrastructure.

For transition to a climate neutral economy, Ukraine has to annually raise approx. 5% of its GDP in investment.

Costs households spend on power and heating equipment, vehicles, etc. contribute greatly to developing a technology-based economy and should be invested in energy efficiency, renewable energy, smart demand side management systems, etc.

8.2. Financial policy and government support of transition

Most investment will be done by private players, particularly grid operators. It will require a change in the tariff-setting approach from cost plus pricing to mechanisms encouraging investment.

Pricing policy should envisage no end price regulation but contain framework conditions for everyone including expansion of the environmental tax base, taxation of externalities related to fossil fuels and an emissions trading system (incl. secondary market).

Support schemes for renewable energy will determine the cost of electricity/heat/cold generation on a competitive basis and promote replacement of monetary support (privileged prices, feed-in tariffs) by other forms of support (preferential grid connection, priority grid access, etc.).

The Energy Efficiency Fund will seek to improve its warm loans and products for their simplification and greater differentiation to scale up thermal renovation of apartment buildings and single-family homes.

Any support provided by the Government shall not conflict with the Energy Community Treaty and the Association Agreement entered into by and between Ukraine, on the one hand, and the European Union, the European Atomic Energy Community and their state members, on the other hand, i.e. shall not distort market competition.

Government support for fossil fuels is allowed only for decarbonisation measures and/or measures aimed at achieving Ukraine's strategic goals of enhancing energy security and reaching energy independence, incl. mandatory assessment of the support for its compliance with the Ukrainian legislation and the EU's Acquis Principles. The respective approach to government support for fossil fuels should be developed in a mid-term perspective, in particular by determining the applicable criteria by the Cabinet of Ministers of Ukraine.

The priority areas for government support through direct subsidies and fiscal incentives include energy efficiency for buildings (in particular, residential buildings), clean transport, research and development, export of services and others. Some funds and programmes will be focused on co-financing of municipal energy transition initiatives, e.g. Mayors Agreement and 100% renewable energy. All projects and programmes supported by the Government should have clear KPIs and independent result verification.

9. SOCIAL SUPPORT AND CONSENSUS

9.1. Information campaigns and communications

Building a public consensus on the green transition will require a change in the approach used by the Government for its communications, i.e. a switch from conventional information campaigns targeting no specific audience to communications tailored for change agents – market players, investors, active consumers.

Enshrining market practices, prosumers, energy cooperatives and condominiums in legislation as full-fledged energy market players will enable their potential as energy transition beneficiaries.

Along with consumer empowerment, communications should focus on economic growth and social welfare, in particular, rising employment and entrepreneurship development opportunities.

9.2. Socially vulnerable people

The main mechanism for supporting vulnerable consumers should be targeted social support depending on the individual household's income. All benefits and subsidies should be monetised and accrued based on the total cost of energy (inclusive of taxes and duties). Social support reform should lead to a decrease in the number of consumers eligible to receive such support to the average level across the EU (up to 10%).

In parallel, we need to implement other consumer protection mechanisms: practical application of individual bankruptcy and debt restructuring, consultancy on energy saving, soft financing and/or subsidies to help households replace inefficient energy-consuming appliances.

One of the key solutions for vulnerable consumers should be better access to state-financed energy efficiency programmes. Gradual penetration of smart energy-consuming devices and the Internet of Things will create opportunities for consumers—first industrial, but later residential—to earn money in the market. This includes both demand side management and using residential systems to store energy and participate in grid balancing.