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SWEDEN

CONTENT

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NEW ENERGY STRATEGY OF UKRAINE UNTIL 2020: SECURITY, ENERGY EFFICIENCY, COMPETITION

The proposed "New Energy Strategy of Ukraine until 2020: Security, Energy Efficiency, Competition" (hereinafter referred to as NES 2020) is a comprehensive document for reforming the energy complex of Ukraine for the period until 2020. At the same time, NES 2020 defines, above all, the goals and algorithms for energy sector development, and thus will also remain relevant for creating further long-term strategies and sectoral programmes. Target figures mentioned in the document only demonstrate the general trajectory of energy resources demand and offer development. These figures are to have a more expanded and detailed presentation in the developed action plan of the CMU for implementation of NES 2020.

Usually, a strategy, being a document that is the result of target-based programme planning and forecasting in a certain sphere of activity, covers a longer period of time – 10-20 years. However, serious challenges currently faced by Ukraine as a state, given the fact of external aggression and the burden of unresolved issues accumulated during the period of independence with reforming of the national energy complex, require a document with such status for a shorter period of time.

The NES 2020 stipulates that by the end of its implementation term the restructuring of the energy complex of Ukraine will be complete, including its transition to modern market models of operation, and that the main safety and energy efficiency targets will be achieved. After 2020, Ukrainian energy sector will move on to a new level of its development – complete integration with the EU energy sector and innovative rebuilding. Thus, implementation of tasks in the energy sector after 2020, will require rather different approaches than those defined by NES 2020, which means – development of a new strategic document.

During the development of NES 2020, proposals were considered regarding the content of the suggested document from such respected international organisations, as the International Energy Agency, Energy Community Secretariat, United Nations Economic Commission for Europe, World Bank, Delegation of the European Union to Ukraine, European Bank for Reconstruction and Development, etc. At the final stage of public consultations regarding NES 2020 draft, an expert discussion was organised, which involved representatives of leading scientific research institutions, companies working in the field, international organisations and NGOs, domestic and foreign experts, media, and based on results of which, the final draft of NES 2020 was created.

This document was developed by the Razumkov Centre and other leading non-governmental, public organisations and scientific research institutions of Ukraine, with support of the Verkhovna Rada of Ukraine Committee on Fuel and Energy Complex, Nuclear Policy and Nuclear Safety. Therefore, the draft of NES 2020 can be rightfully viewed as a result of joint effort of Ukraine's expert community and reputable international institutions.

INTRODUCTION

An updated Energy Strategy of Ukraine until 2030 was approved by the Cabinet of Ministers of Ukraine on 24 July 2013 and was at once severely criticized. Leading domestic and foreign experts in the energy sector stated that this document was more like a set of assessments of energy industry segments, rather than a clear comprehensive strategy, which must contain not only recommendations, but also specific measures (action plans) and mechanisms for their implementation.

As opposed to being associated only with the respective industry, the Energy Strategy must be the document that is aimed at intersectoral cooperation for efficient and reliable satisfaction of needs of national economy and citizens' needs for the necessary kinds of energy. The energy complex of Ukraine must undergo a period of transformation, not only due to specific industry factors, but also because of social and economic changes in the country taking into account the security needs related to external military and political aggression.

The suggested "New Energy Strategy of Ukraine until 2020: Security, Energy Efficiency, Competition", hereinafter referred to as NES 2020, has been developed in the framework of Sustainable Development Strategy "Ukraine – 2020" and approved by the Order of the President of Ukraine dated 12 January 2015 No.5/2015, which includes, within a specified direction of development, an Energy Sector Reform and Energy Efficiency Programmes.

NES 2020 lays out the goals, tasks and implementation mechanisms for bringing the energy complex to the fundamentally new qualitative level of development. Above all, NES 2020 is aimed at solving the issues of energy supply security in a situation, where the country has to live and function under conditions of military and non-military aggression; it offers transformation mechanisms, and its implementation is designed for the midterm period until 2020. After this, it shall be superseded by a new document, which must be consistent with the National Security Strategy, and namely, in the part concerning protection of critical energy infrastructure.

The main goal of energy sector development for the period until 2020 is to ensure the security of energy supply and transition to efficient and energy-saving use of energy resources with introduction of innovative technologies.

Strategic vision: The Energy Sector of Ukraine in 2020 is the economic guarantee of state sovereignty, an element of good governance and a reliable basis for sustainable development of competitive economy, as well as an indispensable part of the European energy space. During the development of NES 2020 we took into account the long-term strategic goal – to bring the country to the level of energy self-sufficiency until year 2030.

Being a member of the European Energy Community and having signed the Association Agreement with the EU, Ukraine has to conduct a parallel "reform-and-integration" process, which should become a strategic guideline for the work of the Government and the Verkhovna Rada of Ukraine during the five-year period. **The key point of this process: the reforms of energy sector facilitate integration into EU energy space, and integration of energy networks facilitates internal reforms.**

Oil, gas and coal production industries, production and supply of electricity, thermal power and water sectors currently reflect interests of corporate entities; the work of regulatory authorities does not have the necessary legal basis to recognise them as independent from the non-economic influences.

NES 2020 defines the action plan for reaching specific goals:

- **Create an energy-efficient society;**
- **Lay a strong energy sector foundation for the development of competitive economy;**
- **Ensure safety and stability of energy supply and transportation;**
- **Integrate into the EU energy space and strengthen global connections.**

Reduction of energy intensity of economy, as well as diversification of energy sources and supply routes will contribute to increased economic, energy and environmental security, which will lead to optimised energy balance and will lay a strong foundation for sustainable energy future of the country. Using national scientific, technical and technological achievements will also contribute to innovative development of economy, growth of economic and energy security, development of scientific and educational potential, improvement of employment rate, reduction of dependence on import, etc.

Due to current military-political and financial-economic situation, a significant reduction of TPES is expected in 2014-2015. Alternatively, **in 2016-2020, Ukraine has to execute an ambitious task – reduce TPES and increase GDP through creating an energy-efficient society. As a result of implementing NES 2020 measures, it is planned to reduce energy intensity of GDP by 20%, which shall allow, on condition of GDP growth, to reduce TPES at least by 10% until 2020 compared to 2012.** Execution of this task will require both significant investments and structural changes in the economy.

It is planned that the share of gas in the TPES composition in 2020 will be significantly reduced – from 34.8% to 28.7%, and the share of coal will be slightly reduced – down to 33.1%. Instead, the shares of oil and petroleum products, as well as nuclear energy are expected to have a several percent increase. The greatest increase rate will be observed for RES, as a result of alternative energy development in Ukraine, – their share in the TPES composition will increase by 2.5 times – from 2% to 5%.[1]

Ukraine should take advantage of the great potential of reducing the use of imported natural gas through saving energy. Realisation of this potential does not require significant financial resources in comparison with the cost of creating additional new alternative energy facilities that could substitute natural gas reduction. Cost savings from the reduced purchase of imported gas almost cover the infrastructural energy saving expenses for its replacement, and such investments have a short payback period. Ukraine should develop a policy of incentives to involve private sector in energy saving in order to receive the required investments.

The document lays out key areas for energy reforms and investments in reconstruction and modernisation of energy infrastructure. Implementation of a complex of structural reforms in the energy sector will allow to raise the competitiveness level of national energy industry, strengthen the level of energy security of the country, create conditions for retrofitting and upgrading not just the energy sector of the country, but the industry of the country as a whole.

Development of energy sector should be flexible in order to use the possibilities offered by energy efficient technologies, as most of the buildings and industrial facilities currently in use have extremely low energy efficiency. **Improvement of the energy sector is to be the first step to recovery and growth of Ukrainian economy.**

Reforms, demonopolisation, transparency, further development of legal and regulatory mechanisms should become the basis for investments. The state should make minimal investments, while creating the most favourable investment climate. The main pre-requisites and sources of investments: de-offshorisation of economy, implementation of stimulating tax and regulatory legislation, economically sound tariffs and international investments. The share of direct investments from the state budget of Ukraine in the energy infrastructure development is not to exceed 5-10%. The total volume of investments from all sources is estimated at 1,300 bln. UAH.[2]

Based on NES 2020 provisions, the CMU shall prepare a decision on defining the role of executive power authorities and their actions in preparing and developing measures for effective energy consumption, competitive and transparent markets for electricity, gas, oil, heat and coal.

NES of Ukraine 2020 was developed using target-based programming approach. Unlike previous energy strategies, including the officially valid one, the method of predicting the future state of the energy system is replaced with creating a specific programme to achieve the desired results. **An algorithm is defined for achieving each NES 2020 goal.** We have to note that in the *complicated situation of economic transformation, political instability and military aggression there are no valid predictive models, that is why the task of NES 2020 is to define the road map for the development of energy sector and mechanisms for attaining the defined goals. Target figures mentioned in the document are not meant to be invariable constants, but rather to be used as reference figures. Thus, their adjustment is planned depending on scenarios of socio-economic development of Ukraine.*

The distinctive feature of the new NES of Ukraine 2020 is the consideration of influence on the existing energy system and its structure through programme elements targeted directly at changing the system, first of all, in the gas and electric power sectors, as well as providing guidelines for implementation of fundamentally new projects.

NES 2020 is subject to discussion with stakeholders, which will help kick-start respective coordinated actions of the Government, the Verkhovna Rada of Ukraine, industry and society. Consumers and small manufacturers and suppliers of energy are to be considered full-fledged stakeholders and have adequate protection.

1 Or over 7% of final energy consumption.
2 At the exchange rate of 22 UAH for 1 USD.

GLOSSARY

ACER – Agency for the Cooperation of Energy Regulators

AMC – the Antimonopoly Committee of Ukraine

Chornobyl NPP – Chornobyl nuclear power plant

CHP – combined heat and power station

CMU – the Cabinet of Ministers of Ukraine

Common market – electricity market of several countries with a mechanism of meeting the demand for electricity based on the principle "from minimum to maximum price", regardless of the country of electric power supplier or consumer

COP – coefficient of performance

CRSNF – centralised repository for spent nuclear fuel

DHC – district heating company

EITI – the Extractive Industries Transparency Initiative

ENTSO-E – European Network of Transmission System Operators for Electricity

ENTSO-G – European Network of Transmission System Operators for Gas

EU – the European Union

European Network Codes (Eurocodes) – European Union standards in corresponding energy transfer infrastructure (networks), such as: groups of codes for electricity networks, groups of codes for natural gas transmission and distribution networks, implemented in line with Regulations (EC) 713/2009, (EC) 714/2009, (EC) 715/2009

FEC – final energy consumption

GDP – gross domestic product

GIE – Gas Infrastructure Europe

GPP – gas processing plant

GTS – Ukrainian gas transportation system

HEP – hydroelectric power plant

HVDC – High-Voltage, Direct Current (high-voltage electricity transportation system based on direct current)

IAEA – International Atomic Energy Agency

IEA – International Energy Age

IGS – isolated generating station

Khmelnytskyi NPP – Khmelnytskyi nuclear power plant

LNG – liquefied natural gas

NATO – North Atlantic Treaty Organization

NERC – National Commission for State Energy and Public Utilities Regulation (national regulator)

NES 2020 – New Energy Strategy of Ukraine until 2020: security, energy efficiency, competition

NPC – nuclear power complex

NPP – nuclear power plants

OECD – Organization for Economic Co-operation and Development

ORP – oil refinery plant

PPP – purchasing power parity

PSHP – pumped storage hydropower plant

PTL – power transmission lines

RAG – reduction of amount of gas consumption

RES – renewable energy sources

RF – the Russian Federation

Rivne NPP – Rivne nuclear power plant

South Ukraine NPP – South Ukraine nuclear power plant

TPES – total primary energy supply, calculated as the sum of production (extraction), import, export, international bunkering of vessels and changes of country's energy reserves

TPP – thermal power plants

UCTE – Union for the Co-ordination of Transmission of Electricity

UEM – unified electricity market

UGS – underground gas storage facilities

UPS of Ukraine – unified power system of Ukraine

V4 – an interstate alliance of the "The Visegrad Four" group of countries

VAT – value added tax

VR of Ukraine – the Verkhovna Rada of Ukraine

WTO – World Trade Organization

Zaporizhzhya NPP – Zaporizhzhya nuclear power plant

1. ENERGY SECTOR OF UKRAINE: TENDENCIES, PROBLEMS, PROSPECTS

1.1. POLITICAL AND ECONOMIC ASPECTS OF NES 2020 TASKS IMPLEMENTATION. FOREIGN AND DOMESTIC THREATS TO UKRAINIAN ENERGY SECURITY

1.1.1. Global Tendencies in Energy Industry

The world of rapidly growing population entered the XXI century – an era of a "global hunt" for energy resources. Countries with surplus resources are in the minority and, as a rule, they belong to a different civilization space than the countries that consume energy resources. An urgent need for climate change control is to decarbonise energy systems. Consumer countries can be divided into industrially developed ones that work on decarbonisation issues, and those that develop their energy consumption disregarding the need for decarbonisation. Thus, the "global hunt" for energy resources and decarbonisation are automatically complicated by the "clash of civilizations", which increases the turbulence in the development of global energy industry.

Transition to recovery of unconventional hydrocarbon reserves increases competition between energy sources flows in global and regional dimensions. As such, **some leading production countries have established a monopoly status of their state companies for certain export routes and are trying to preserve it at any cost, despite the global energy market tendency for increasing competition. This poses a serious challenge for a number of consumer countries, including Ukraine.**

The International Energy Agency (IEA) has declared the onset of the "golden age of gas", as the cleanest fossil fuel and the one that has minimal CO_2 emissions and meets the decarbonisation objectives. At the same time, comparatively high prices for hydrocarbons and significant cost of recovering energy from RES draw attention to new ways of using coal and nuclear fuel for production of electricity and heat. The interfuel competition is increasing. Production of unconventional hydrocarbons is growing, which contributes to bigger competition at traditional fuel markets.

Electricity, due to its versatility and portability, has been enjoying a growing demand. **Revolutionary technological innovations are expected to take place in transport industry. In the future, within the next several decades, transformation of major part of transport into non-emission, environmentally clean, electric transport using the internal combustion engine will take place.**

Thus, the growing competition at global energy markets opens broader possibilities for Ukraine regarding the choice of sources and ways of supplying primary energy resources, optimisation of energy mix and, in perspective, reduction of CO_2 emissions. At the same time, new challenges arise in connection with intentions of third parties to impose on Ukraine the "game rules" different from the regional (European) ones.

1.1.2. Priority of Energy Security Issue

Throughout the entire period of Ukraine's independence its energy sector remains the most vulnerable segment of economy. None of the strategic goals – reduction of GDP energy intensity, intensification of recovery of own energy deposits, diversification of energy sources and supply routes, creation of a strategic oil reserve and elements of a nuclear fuel cycle, comprehensive development of alternative energy – were reached.

Throughout the entire period of Ukraine's independence, its leadership chose the model of commercial exploitation of existing energy dependence of the country on external supply, rather than the model of ensuring energy security and independence from the monopolistic energy supplier. Regional tendency to use energy as a tool of political and economic influence makes it inefficient to continue using this model of commercial exploitation of energy dependence and necessitates renouncing this model.

Energy security issue gains paramount importance for successful development of countries dependent on energy imports. In this context, the success of any such country in its economic development is ensured not only by direct access to energy resources. In conditions of international instability, countries that have energy resources deposits, are trying to secure energy self-sufficiency. **In the case of Ukraine, prudent use**

of domestic energy resources combined with the necessary import must be based on a balanced energy security system. This system must be flexible and able to function in regular circumstances, as well as in emergency situations. Such system will become one of the guarantees of country's survival in unfavourable external conditions, preservation of its sovereignty, territorial integrity and further economic development.

1.1.3. Energy Security Formula

Basic configuration of the energy security formula: conservation of energy and energy efficiency + own energy resources ***(coal, natural gas, oil, biomass + other renewable energy sources)*** + diversification of import + strategic reserves + integration into EU energy space (connected and synchronised energy networks).

Special attention should be paid to preventing the establishment of control over the critically important infrastructure by the parties that ignore Ukrainian and EU energy legislation and whose aims are: non-transparent acquisition of energy assets, destabilising energy markets operation and obstructing their diversification under the pretext of attractive commercial projects, etc.

1.2. UKRAINIAN ENERGY INDUSTRY: BETWEEN RUSSIA AND EU

Geographical location of Ukraine between the EU and Russia and the act of external aggression of the latter against Ukraine create both challenges and opportunities. The challenge is the loss of Ukraine's status as a transit country, the opportunity – a chance to disengage from dependence on Russian gas imports. However, under conditions of general shift of global energy resources trade towards Asia, the beginnings of a transatlantic energy partnership, the absence of a unified EU position in the issues of energy security, as well as Russia's strategy to create non-transit hydrocarbons export systems, the transit role of Ukraine will not be as significant, as it used to be before the first wave of global financial crisis in 2008-2009. It was the latter one that led to revision of many economic, financial and energy realities in Europe and in the world.

Although in the EU-Ukraine Memorandum of Understanding on Energy as of 1 December 2005 it is stated that "Ukraine is a key transit country for hydrocarbon supplies to the EU", on the overall, **the EU strategy is no longer focused on the potential of Ukraine as the key energy transit route in the East, as the interests of separate member-countries prevail over jointly defined priorities.**

EU is an important player on the European and global energy market, however it remains rather vulnerable to different influences, primarily related to energy dependence. As a result, the active role of the EU as a full-fledged energy player on the pan-European level is being constantly diminished.

Liquid and competitive European energy market prevents violations on the part of suppliers. Well-developed trading mechanisms of the spot market allow its participants to find effective solutions to solve short-term problems of energy security in the procurement of the necessary volumes of oil and coal. This experience is extended to gas (LNG) and electric power trade, guaranteed availability of free throughput capacity of gas pipelines, LNG terminals and PTL. Ukraine has to join the EU market through its membership in the Treaty establishing the Energy Community.

Postponing implementation of European guidelines or their inadequate implementation by Ukraine can lead to automatic segregation of Ukrainian energy market from the EU energy space with serious long-term negative consequences for the country. **Application of European energy standards in Ukrainian legislation can significantly increase Ukraine's resistance to any attempts to politicise interstate relations in the sphere of energy supply, and participation in the general European market will allow to increase transparency of domestic energy markets.**

1.2.1. Influence of Russia's Energy Strategy and Policy on Energy Security of Ukraine

The Russian Federation continues to pursue its course of using energy resources and their supply infrastructure to achieve its economic and political goals. **Refusing to respect European rules in the energy sector, Russia is trying to reformat energy relations in the European space based on its own ideas and models.** Legally not being a party in Ukraine-EU energy relations, Russia nevertheless is actively trying to influence them, using all means available, – economic, political and informational. The basis of most of them is the reliance on covert bilateral relations, which have proven to be the most effective on the former Soviet space.

Updated in 2009 the Energy Strategy of the Russian Federation until 2030 retained and expanded a number of key pipeline projects, implementation of which will

continue to make significant changes to the infrastructural map of the region. The Energy Strategy focuses on building new export corridors in the East, non-transit energy supply systems in western Russia, and marine export terminals in the adjacent seas.

In circumstances, when the Russian side tends to use energy resources and pipelines as a tool of political influence, this energy policy can seriously destabilise the East-West hydrocarbon streams, and impair the stable functioning of pipeline infrastructure in transit countries, especially, in Ukraine. At the same time, this challenge is an additional incentive to reconfigure a part of Ukrainian GTS capacity to reverse flow mode and to enhance the level of energy security.

1.2.2. Strategic Course of Ukraine

Our strategy is to bring the country to the level of energy self-sufficiency until 2030 (dependent on successful development of natural gas deposits in unconventional sources), and energy independence until 2025 (through conservation of energy and maximum diversification of primary energy resources supply).

Taking into account Ukraine's membership in the Treaty establishing the Energy Community, respective provisions of the Association Agreement with the EU, its key priority must be the task of transforming the legal framework, the regulatory environment, and the functional purpose of energy infrastructure.

Reform of national regulators in accordance with EU legislation, Ukraine's commitments as a member of the Treaty establishing the Energy Community and EU's best practices shall create foundation for transformation of the energy sector so that it not only guarantees the country's energy security, but also represents an example of effective energy-saving production and consumption.

Traditionally, since the Soviet times, gas and oil transportation systems, electric power networks have been and still are largely a technological component of the former Soviet energy infrastructure, adapted to exporting energy resources from Russia. As a result of a system transformation, they are to become:

- a flexible tool for Ukrainian energy security system;
- a foundation for reliable provision of energy to consumers;
- a system link in the security of supply to the EU from the eastern direction (in case such supplies are continued in the future).

In order to reach the main NES 2020 goals, the following **general tasks** are planned:

A) Ensure energy independence, including creating strategic reserves, diversification of energy sources and supply routes.

B) Reduce GDP energy intensity for 20% by 2020 as compared to 2012.

C) Ensure functioning of competitive and transparent markets for electricity, heat, gas, oil and petroleum products, coal, etc. taking into account the external aggression factor.

D) Create and regularly monitor energy inventory of Ukraine, conduct its assessment according to efficiency criteria.

E) Ensure stable functioning of energy infrastructure, including security of key facilities.

F) Facilitate investment attractiveness (encourage investments).

G) Improve legislation that regulates the energy sector with regard to *acquis communautaire* requirements.

H) Train specialists and secure scientific and technical support.

I) Ensure protection of critical energy infrastructure.

Implementation of an effective energy policy requires political will, professional planning and implementation, comprehensive analysis, high-quality statistics, public dialogue and continuous monitoring of progress indicators.

For timely execution of these tasks it is necessary to improve legal and institutional infrastructure. This must be done within the next 3 years – until 2017, and starting from 2017 till 2020, simultaneously, the focus should be on market development and investments in the infrastructure. In particular, the main focus is to be on completing the practical phase of market development – eliminating cross-subsidies, building up the market liquidity and active competition in generation, trading and supply of energy.

1.2.3. Energy Mix

Traditionally, consumption structure of primary energy resources is characterised by an exaggerated proportion of natural gas in TPES, which in 2012 was 34.8%. Optimisation of TPES with the aim of reducing this share is to become one of the permanent tasks of the government during energy sector reform.

It is important not only to keep the current dynamics of reducing gas consumption share in TPES (in 2000-2012 gas share has been reduced from 44% to 34.8%), but also to facilitate its further reduction to the level approaching European average – 24% in 2025.

The task for year 2020 is to reduce the gas share in TPES at least by 5% as compared to 2012 through increased shares of RES and nuclear energy.

TPES prognosis for 2020 shows that coal (33.1%), gas (28.7%) and nuclear energy (21.7%) will still remain its main components.

1.2.4. Energy Sector Vulnerability Zones

1). Coal sector: *unprofitability of production, obsolete technological level, partially destroyed mines and infrastructure, regressive development (makeshift coalmines)*.

2). Hydrocarbon sector: *dependence on Russia, worn-out pipeline systems, dominant influences of oligarchic groups, partial loss of assets, hydrocarbons deposits and production prospects (the Black Sea shelf), lack of market structures, including cost-reflective network tariffs and market based energy pricing, lack of adequate political and financial independence of the national regulator* (*NERC*).

3). Overall electricity sector: *outdated, insufficient and aging infrastructure, high market concentration (monopolism) with non-transparent system of cross-subsidies and missing platforms for competitive forms of trading, comparatively low regulated prices that create no true price signals or incentives for investments, inadequate regulatory foundation, high energy intensity and low energy efficiency*.

4). Nuclear energy sector: *fuel and technological dependence on Russia, low electricity tariffs, subsidising private heat and power sector, the need to decommission part of generating capacities*.

5). Combined heat and power industry: *worn-out state of main assets, dominant influences of separate oligarchic groups, partial destruction of generating facilities and infrastructure*.

6). RES sector: *partial loss of assets of wind and solar energy in Crimea, unbalanced development, insufficient manoeuvre capacities, excessive tariffs*.

7). *Common problems for all energy sectors are still non-transparency and high level of corruption*.

Partial loss of energy assets due to annexation of Crimea and damage to energy infrastructure facilities in the aftermath of military events in the East of Ukraine are additional aggravating factors in terms of country's energy supply.

Because energy resources (gas) have become one of the instruments of a hybrid war against Ukraine, and energy infrastructure (pipelines, mines, energy generating capacities) has come under the threat of destruction, a set of measures must be developed to minimise the negative effects.

An important task is to review contractual arrangements regarding the supply of Russian gas to Ukraine, the asymmetry of which allows for financial weakening of the state and for preserving Ukraine's dependence on Russian gas.

1.3. TARGET AND FUNCTIONAL TASKS, PRIORITIES

1.3.1. Functional Tasks

Formation of energy-efficient society	• Energy conservation and energy efficiency; • Creating an energy-efficient mind-set among citizens
Ensuring energy self-sufficiency	• Minimising import through the development of own resource potential; • RES development; • Optimising the energy balance; • Reducing energy losses in transmission and distribution; • Improving metering and payment discipline; • Creating a strategic reserve; • Flexibility and mutual substitution of fuel types; • Security of energy infrastructure
Development of markets	• Functioning of competitive and transparent markets for electricity, heat, gas, oil and petroleum products, coal, taking into account the external aggression factor; • True independence of the national energy regulator (NERC) from any political influence (incl. subordination to the President of Ukraine), financial independence and independent decision-making without review/veto rights of other public institutions; • Abandoning the cost-plus pricing policy, transition to pricing methods that are more oriented at market conditions
Ensuring investment attractiveness	• Using the benefits of EU partnership; • Ensuring the rule of law principle; • Improving legislation that regulates the energy sector with regard to *acquis communautaire* requirements
Improvement of management	• Transition from sectoral to functional model; • Training employees and scientific work; • Involving public

1.3.2. Target Tasks

Target Task No.1 (ENERGY EFFICIENCY AND CONSERVATION OF ENERGY +)

Ensuring conservation of energy through implementation of energy efficiency programmes according to EU Directives on Energy Efficiency and Energy Performance of Buildings. In conjunction with intensification of traditional gas production, and in the future – with the development of unconventional gas resources, which will help Ukraine gain independence from imported energy sources. On the regional level, programmes must be adopted for energy saving and the use of local fuel and energy resources for heat generation, for example, from biomass.

Target Task No.2 (INTEGRATION+)

The best way for Ukraine to integrate its energy infrastructure into European energy space is through the Central-Eastern Europe regional energy platform (on the basis of the Visegrad Group – V4), which was created after the gas crisis of 2006. It has been engaged in a number of rather successful projects with financial support of the European Commission and aims at decreasing the degree of vulnerability of countries in the region from energy supplies from the East, and increasing the level of energy security through synergy of effort. The Visegrad Four expands the format of cooperation with its neighbours according to formula V4+ and assists them in using the benefits of EU partnership.

Network operators' membership in ENTSO-E and ENTSO-G, integration of the power system with neighbouring markets – at first stage, with the power system of Moldova and, at second stage, integration with the synchronised EU power system (ENTSO-E and ENTSO-G), joint regulatory policy, improvement of legal basis that regulates the energy sector taking into account the *acquis communautaire* requirements, – these are the top priority tasks for Ukraine's energy system integration into a common European legal space.

The integration of energy markets with the corresponding markets of Moldova is not a transitory measure but rather a strategic step that includes potential benefits for both parties in various types of diversification, improved geopolitical position and system security (taking out the adverse factor of Transnistria), exploitation of synergies and development of versatile market environment and best regulatory practices.

The next immediate step in the integration is development of interconnections, including temporary use (before the full synchronisation with ENTSO-E is achieved) of back-to-back HVDC conversion units, which allow for transfer of electricity both ways between the systems, without the need for synchronisation. This shall allow for increased trading potentials with commercial benefits and investment prospects, as well as for increased system security and security of supply in general. The same technology (same DC conversion units) could later be applied on the RF and Belarus borders once the ENTSO-E synchronisation is completed.

Target Task No.3 (HYDROCARBONS+)

Reduced consumption of natural gas to the level of 40 bln. cu.m/y already in 2015 (as opposed to 50 bln. cu.m/y in 2013) with simultaneous diversification of its import.

Consumption: 40 bln. cu.m/y = 20 bln. cu.m/y of own production + 20 bln. cu.m/y imported.

Import: 20 bln. cu.m/y = 5 bln. cu.m/y from the RF + 15 bln. cu.m/y through the EU.

Import from the EU: 15 bln. cu.m/y through Slovakia, Poland, Hungary.

Further implementation of transparency mechanisms in extractive industry.

Introduction of innovative technologies in oil production and refining.

Target Task No.4 (ELECTRIC POWER INDUSTRY+)

The first step is completion of implementation of the Third EU Energy Package in order to provide regulatory foundation for the electricity market within the legal system of Ukraine. This is Ukraine's obligation according to the Energy Community Treaty, which paves the way for implementation of reforms and serves as a pre-condition for further integration into the EU electricity market and participation in other EU associations. In order to complete the reform process, a prompt restructuring of DP NEK Ukrenergo is required, which includes division according to types of activity, and sale of state shares of power generating companies in the heat and power industry.

Subsequently, implementation of the provisions of the Law of Ukraine "On the Principles of Functioning of Electricity Market in Ukraine" should take place simultaneously with introduction of further changes into the law, based on recommendations of the Energy Community, which will provide the legal foundation for electricity market reform, de-monopolisation (elimination of the dominant position of a single business entity), elimination of cross-subsidies, development and adoption of the corresponding law on the national regulator, development of required rules, implementation of conditions and rules required for exchange of energy and integration with ENTSO-E, etc.

Diversification of nuclear fuel supply through expanding cooperation with leading global companies, increased stock of nuclear fuel, construction of two nuclear power reactors at Khmelnytskyi NPP and creating a nuclear fuel production factory on a modern technological basis in line with IAEA and European standards. Construction of a Central repository for spent nuclear fuel. Building new NPP units using non-Russian technological basis.

The issue of decarbonisation in the period until 2020 will be mainly solved in Ukraine through reduction of the energy intensity of Ukraine's GDP by 20% and general reduction of the TPES by 10%, as well as through increasing the RES share in TPES composition (from 2% to 5%). In compliance with Directive 2009/28/EC, a National Action Plan on Renewable Energy for the Period until 2020 is to be developed and approved. Also, in compliance with Directives 2010/75/EU, 2001/80/EC, Ukraine is to develop and approve a National Action Plan for Reduction of Pollutant Emissions from High-Capacity Combustion Plants (50 MW and over), similar to national plans for reduction of emissions of EU member states.

1.3.3. Continued Focus Priorities

- Thermal modernisation – conservation of energy – energy efficiency;
- Diversification of gas supply through cooperation with EU countries, Norway and, in the long view, with the USA and Canada;
- Diversification of nuclear fuel supply through cooperation with the USA;
- Improving the system of enhanced protection of critical infrastructure based on the best practices of NATO and EU member states;
- Returning the extractive industry assets on the Black Sea shelf;
- Development of natural gas extraction from the shallow shelf of the Black Sea, and after the return of Crimea to Ukraine's legal system – from the deep shelf as well, involving leading American and European companies;
- Creating competitive markets for gas, electricity, biofuel, coal, oil and petroleum products;
- Ensuring long-term sustainability in all measures related to the following: improved security of electricity supply, RES incentive mechanisms, environmental impact of the energy infrastructure, programmes of maintenance and substitution of production facilities, application of new and "smart" technologies, cost reimbursement through regulation of end-user supply prices in order to support consumers outside of competitive markets, the so-called "Guaranteed Supply Company or Supplier of Last Resort", etc.;
- Ensuring true independence of the national energy regulator (NERC) from any political influence (incl. subordination to the President of Ukraine), financial independence and independent decision making without review/veto rights of other public institutions;
- Creating strategic fuel reserves in cooperation with neighbouring EU member-countries;
- Retaining state control over existing strategically important infrastructural assets: GTS, UGS, main oil pipeline system and NPP;
- Balanced expansion of the renewable energy niche (biomass, wind, solar, etc.);
- Increasing the manoeuvre capability of electric power industry and operation of market-based balancing mechanisms;
- Modernisation of electricity and gas distribution networks;
- Implementation of Extractive Industries Transparency (EITI) mechanisms.

Resolving the above issues will allow creating after 2020 a more balanced energy system, which can not only transform into a self-sufficient system, but also become a contributor to European energy security after 2025.

1.4. GENERAL ECONOMIC CONDITIONS FOR SUCCESSFUL ENERGY INDUSTRY REFORM

Reform of the energy sector is a condition for successful economic reforms. The success of achieving energy independence scenario is possible only if the necessary economic basis is created for this by 2020. In addition to effective anti-monopoly and tax policies stimulating the development, it is necessary to solve problems beyond the limits of energy sector:

- de-offshorisation of energy industry by prohibiting the use of offshore ownership schemes and account settlements of energy and gas distribution companies (oblenergo – regional power distribution companies, oblgaz – regional gas distribution companies);
- restitution of financial assets that were being withdrawn from the Ukrainian energy sector for a long period of time and were accumulated in offshore accounts, through capital amnesty;
- introduction of a transparent mechanism for state procurements, transition to stock-trading procurement mechanisms;
- creating a favourable investment climate through mechanisms of state-private partnerships and transparent regulation based on European pattern;
- renouncing the practice of budget assistance to natural monopolies through financial instruments;
- ensuring independence in the regulation of the natural monopolies in the energy sector;
- housing and communal services reform.

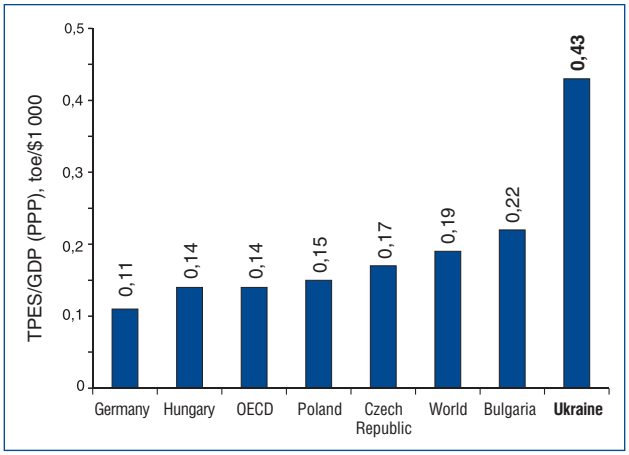
Without the aforementioned economic reforms it will impossible to ensure successful energy sector transformations.

2. SECTORAL PROBLEMS

2.1. GDP ENERGY INTENSITY

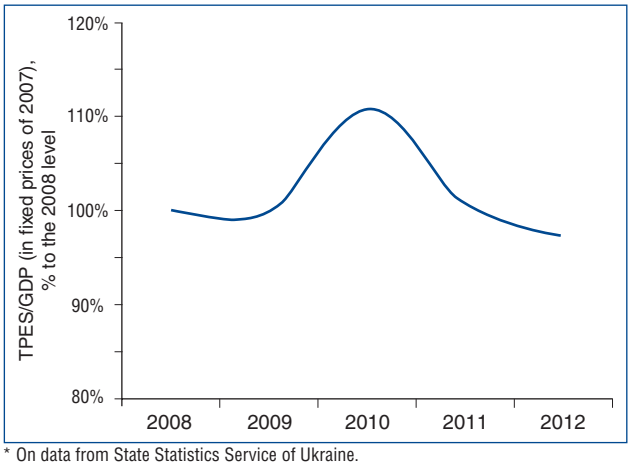
Current GDP energy intensity indicators for Ukraine point to a deep systemwide crisis of its economy. Ukrainian GDP energy intensity is much higher not only in comparison with leading global economies, but also with neighbouring Central and Eastern European countries (diagram "*Energy intensity of GDP...*"). A negative factor is not only the high GDP energy intensity in Ukraine, but also the lack of apparent dynamics towards its diminishing in the past several years (diagram "*The change of energy intensity...*").

Energy intensity of GDP in Ukraine and some other countries of the world in 2011*



* According to data from: Key World Energy Statistics 2013, IEA.

The change of energy intensity of GDP in Ukraine in 2008-2012 *



* On data from State Statistics Service of Ukraine.

The high level of GDP energy intensity is caused by several factors.

First. The distorted structure of GDP. Its significant share is formed in resource- and energy-intensive industries – iron and steel industry, large-scale chemical manufacturing, fuel and energy complex and extraction of mineral resources.

Second. Low energy efficiency in energy transformation sector – combined heat and power industry and production of thermal power. Energy supply – transportation and distribution of electricity and thermal power. The average efficiency of coal use in the combined heat and power industry of Ukraine is almost 1.5 times lower than that in commercially available technologies, and electricity losses in networks are 2 times higher than those in Germany and the USA.

Third. High specific rates of energy consumption by households and institutions for heating and hot water supply. The average annual specific energy consumption by residential accommodations in Ukraine is about 270 kW*hour/m^2, which is almost twice as much as the same indicator for European countries with similar climate conditions.

Over the past five years, industrial prices for energy resources have significantly increased. The highest increase was the natural gas price, which caused a significant reduction of its industrial use and reorientation to other energy sources. However, such measures were implemented with insufficient intensity, which is a result of the absence of conditions for fair competition in the country.[1]

2.2. PRIMARY ENERGY RESOURCES (GAS, OIL, COAL)

2.2.1. Gas Sector

Consumption of natural gas in Ukraine is provided by imports and domestic production. The main industrial consumers of natural gas are metallurgical and chemical industry companies, which consume almost *40% of the total consumption volume*.

Over the past 15 years the annual volume of gas production ranged from 18 to 21 bln. cu. m and almost has

[1] The guarantees for competitive advantages are innovation, technological excellence of production and cost reduction.

not changed in the past decade. Almost 90% of production is performed by enterprises of public sector of economy.

Gas sector of energy industry of Ukraine is the most problematic for the country's economy. **The abnormally high gas intensity of GDP not only results in industry dependence on gas imports, but also contributes to scheming and corruption development.**

The main problems of gas sector are:

- the monopoly of NAK Naftogaz Ukrainy (NJSC Oil and Gas of Ukraine), which causes the degrading of gas industry and the outflow of huge public funds;
- an extremely disadvantageous gas sale and purchase agreement between OAO Gazprom (Open Joint Stock Company Gazprom) and NAK Naftogaz Ukrainy for the period of 2009-2019, including the clauses of this agreement that define gas custody transfer points (on the border with EU, and not on the Ukraine-Russia border);
- the need for major GTS modernisation in the situation when NAK Naftogaz lacks funds for it;
- current absence of liberalised and institutionalised market for natural gas in Ukraine required in accordance with the 2nd and 3rd EU Energy Packages;
- lack of true unbundling of system operator PJSC Ukrtransgaz from NAK Naftogaz Ukrainy;
- lack of membership of TSO for gas PJSC Ukrtransgaz in ENTSO-G in compliance with the 3rd EU Energy Package;
- unprofitable work of NAK Naftogaz supplying natural gas to combined heat and power industry and DHC, as well as to population, due to the use of fixed rates that do not cover the cost of natural gas being supplied;

- existence of privileged pricing for specific consumer groups and lack of unified pricing principles for all consumer groups;
- lack of cost-reflective gas network fees and de-regulation of gas prices;
- need for a more targeted definition of socially vulnerable gas consumers in line with the Energy Community recommendations, as well as for an efficient mechanism of targeted compensations for this category of consumers;
- economically unjustified rates of payment for the use of subsoil resources (rental payments);
- unsatisfactory pace of restructuring oil and gas companies in accordance with the requirements of EU Directives on Energy, especially regarding the separation of gas distribution and supply;
- poor conditions for attracting private investors in the development of gas extraction projects – from conventional and unconventional sources.

2.2.2. Oil Sector

Oil production and refining industries of Ukraine have not been refocused to implement new technologies, minimise raw material losses, attain European quality standards and increase the export of petroleum products. It has also been planned that investors will provide ORP (Oil Refinery Plants) with the necessary volumes of raw materials, but this has not happened. Ukraine has remained a minor export market, and domestic plants receive oil according to the leftover principle.

Petroleum products are the fourth most important energy source for Ukraine. Their share in the total primary energy supply structure in 2005-2014 has remained almost unchanged, remaining at 10-11%. In the final consumption of fuel and power, petroleum products make up about 17%, second only to natural gas and thermal power.

In 2013, 3.5 mln. ton of petroleum products have been produced in Ukraine. The share of imports was 78%. In 2008, it was 13.5%. This tendency will remain throughout the period of NES 2020 implementation.

2.2.3. Coal Sector

The structure of mine assets of state coal mining companies indicates the aging of its main assets (40% of all mines have been in operation for over 70 years); we can also point out a significant delay in the pace of reconstruction and technical re-equipment of mines, the presence of obsolete technologies and decreasing of scientific potential in the industry.

The coal industry remains a subsidised industry. The situation was severely complicated due to military events in the East of Ukraine and destruction of coal

industry infrastructure. This leads to imminent closing down of mines, first of all, those that were destroyed or damaged by the aggressor.

Under conditions of external aggression and uncertainty of the future of coal mining in Eastern Ukraine, priority is shifted to the development of Lviv-Volyn coal basin, development of brown coal deposits and combustible shale deposits in Central Ukraine, as well as conducting an independent audit of mine assets and creating an open registry of coal reserves. Vital becomes the task of introducing new technologies of intensive coal combustion at TPP, which will allow to increase the share of use of non-anthracite groups. Also, we need to attend to arranging critical coal imports from the world market and to expansion of respective port and railway infrastructure for coal delivery within the country. The military conflict in Donbas will cause coal production drop in the period until 2020 down to 70 mln. ton/year or by 18% compared to 2012.

2.3. ELECTRIC POWER INDUSTRY

The **main problems** of electric power industry, including nuclear sector, are:

- high degree of physical deprecation and obsolescence of main and auxiliary equipment of power plants, transmission and distribution network facilities;
- destruction of energy infrastructure in the East of Ukraine;
- cross-subsidisation practices;
- comparatively low level of regulated end-user supply prices;
- lack of membership of the national TSO for electricity in ENTSO-E, in compliance with requirements of the 3rd EU Energy Package;
- insufficient regulatory capacity in the UPS of Ukraine;
- unpreparedness of electric power networks to RES development;
- increasing volumes of consumer debt for electricity, debts in WEM (Wholesale Electricity Market);
- existence of privileged pricing for specific consumer groups and lack of unified pricing principles for all consumer groups;
- lack of cost-reflective electricity network fees and de-regulation of electricity prices;
- need for a more targeted definition of socially vulnerable electricity consumers in line with the Energy Community recommendations, as well as for an efficient mechanism of targeted compensations for this category of consumers;

- absence of mechanisms for implementing measures to limit emissions of large combustion plants in electric power industry;
- insufficient financing of measures aimed at increasing NPP security and protection of energy infrastructure in general;
- absence of financing to build new nuclear reactors;
- absence of capacities for domestic production of nuclear fuel.

The **main tasks** of electric power industry, including nuclear sector, are:

- the necessity of implementation of EU Directives and Regulations on Energy within the 2nd and 3rd Energy Package, including the institutional aspects based on independence of regulating bodies;
- development and adoption of an Action Plan for Ukraine's UPS integration with power systems of the neighbouring EU countries: at first stage – with the power system of Moldova, and at second stage, – with the interconnected power systems of EU member states (ENTSO-E synchronised area);
- technical and technological preparation of Ukraine's UPS facilities to integration with ENTSO-E;
- revision and implementation of electricity market legislation in accordance with requirements of EU energy legislation in the frame of Ukraine's membership in the Treaty establishing the Energy Community;
- the need to establish a full cycle of radioactive waste treatment from the moment of its generation until disposal.

2.4. RES POTENTIAL

RES share in the final consumption of energy in Ukraine in 2012 amounted to approximately 3.4%.[2,3] **This indicator is 4 times lower than the average for the 28 EU member-countries.** About 38% of RES energy in Ukraine was produced by HEP in the form of electricity, the production of which has been rather stable for many decades and is mostly provided by Dnipro hydro-power cascade. About 60% of RES energy was received from biologically sourced products (solid biomass, biogas, biofuel, etc.).

The use of RES can potentially improve the level of energy security, as well as reduce human impact on the environment. Thus, together with increasing energy efficiency, it has to become one of the most important areas of Ukraine's energy policy.

Development of RES in Ukraine is at its early stage and requires substantial investment to increase its share in the energy balance, resulting in an additional cost burden for consumers. At the same time, increased energy efficiency can reduce not only direct expenses for energy resources, but also the volume of investments in extractive industry, reduce capacities required for transformation of primary energy resources into secondary and energy infrastructure. Along with this, increased energy efficiency will allow to reduce the burden on the environment.

Technically achievable power potential of RES of Ukraine is estimated at approximately 70 mln. toe/year, which is almost equal to the annual final energy consumption.[4]

The share of RES use in Ukraine has significantly increased since 2009, which has happened under the influence of two main factors:

- the increase of natural gas price for industries and public sector after the "second gas war" with Russia at the beginning of 2009;
- implementation of state policy of stimulating the production of electricity from RES through the mechanism of "green tariff" (Law of Ukraine "On Amendments to Certain Legislative Acts of Ukraine on Introduction of the "green tariff") and tax preferences (Tax Code of Ukraine).

The first factor conditioned a number of industrial enterprises to move to various types of solid biofuel.

Such transition took place mainly in those sectors, where prior to this such biofuel was considered an industrial waste; and produced energy has been used for technological needs. These are: oil extraction, woodworking enterprises and agricultural producers. In the public sector – the use of biomass (wood chips, straw, fuel wood, pellets) to substitute natural gas in heating stations.

The second factor led to explosive development of solar and wind electric power industry, where the production of electricity in the past 5 years increased from almost non-existent to approximately 1.5 bln. kW*h.

The use of RES by households and in district heating systems has not gained a significant place due to low prices for major primary (natural gas) and secondary (electricity) energy forms that are subsidised by the state.

The use of biofuel in transport, because of continuous postponing of practical application of regulations on mandatory content of bio-components in motor fuel, has not widely spread in Ukraine yet.

The main problem of RES use in Ukraine over the past five years was the ineffective state tariff policy due to domination of financial interests of separate financial-industrial groups. This resulted in excessive cross-funding, additional expenses for consumers and a significant decline in product competitiveness in fundamental industries.

2 Energy balance of Ukraine for 2012. – State Statistics Service of Ukraine, 2012.

3 Reliability of data on the use of RES in Ukraine is low. Official figures do not include the use of solar energy for heat production via solar collectors, wind and geothermal energy for heat production via heat pumps, motor biofuels, etc.

4 Estimation of the Institute of Renewable Energy of the National Academy of Sciences of Ukraine.

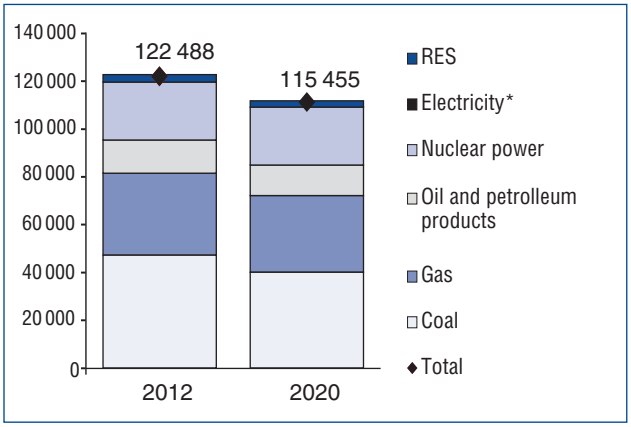
3. PREDICTIVE ENERGY BALANCE. BASELINE SCENARIO

In the NES 2020 predictive balances are created using the economic-mathematical model "TIMES-Ukraine", which is an optimisation model of all Ukraine's energy flows; it meets methodological recommendations of international organisations on the development of energy and environmental forecasts, in particular, the recommendations of Secretariat of the UN Framework Convention on Climate Change.

According to results of the conducted research, NES 2020 goals can be reached, first of all, through reducing total energy consumption and substitution of gas for other energy resources. **Without a hard-line policy on energy efficiency and energy saving, only by limiting the consumption of gas, we cannot expect a significant reduction of energy intensity of Ukraine's economy.**

With the decrease of GDP energy intensity for 20% we need to attain a gradual decrease of TPES for approximately 10% until 2020, with the planned GDP increase (diagram "*Ukraine's TPES...*") through reduced consumption of all types of energy resources except electricity, technological use of which is more efficient.

Ukraine's TPES in 2012 and 2020, thousand toe

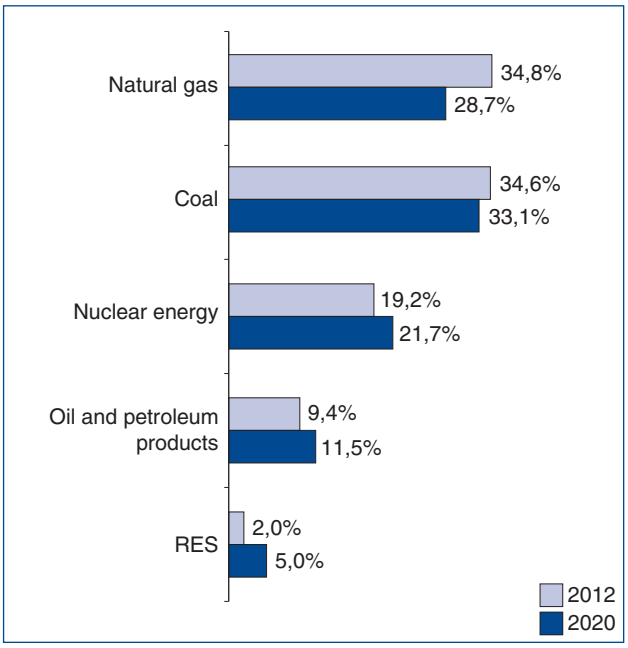


* In this case the indicator has a negative value, as electricity export exceeds its import.

Under such conditions, the reduction of gas consumption could reach more than 22% and its share in TPES would drop from 34.8% to 28.7%. Coal share in TPES composition in 2020 will slightly decrease – down to 33.1%, while the shares of nuclear energy, oil and petroleum products will grow by 2.5% and 2.1%, respectively.

Increased production of energy from RES will be driven by the development of alternative energy in Ukraine (for over 60% through the use of biofuel). It is expected that their share in TPES composition will dynamically grow – from 2% to 5% or 2.5 times, however, under conditions of economic transformations and financial problems in the country, will remain low (diagram "*Ukraine's TPES Composition...*").

Ukraine's TPES Composition in 2012 and 2020, %



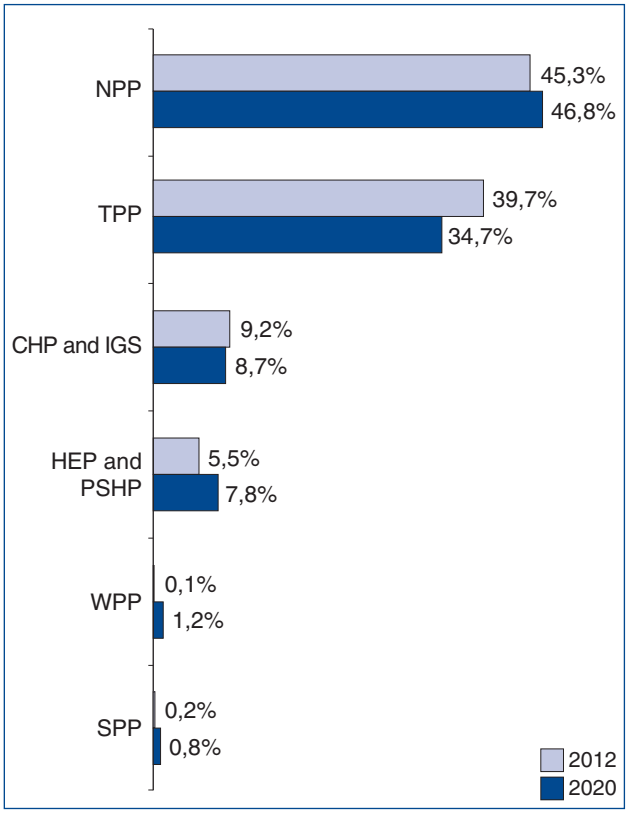
Ukraine's need for imported coal can grow up to 7 mln. ton/year, starting from 2015, due to the need to compensate for the lack of supply from Donbas.

In case of a favourable investment climate, it is predicted that domestic gas production will keep growing and in 2020 will amount to 23 bln. cu. m. Then the demand for imported gas will amount to 15-17 bln. cu. m in 2020. Without a reform of the oil refining industry, oil and petroleum products import can increase from 11.6 mln. toe in 2012 to 15 mln. toe in 2020.

Under conditions of consistent compliance with energy efficiency and energy conservation policy, the expected electricity production increase until 2020 is only 3%. At the same time, energy production structure (diagram "*Electricity Production Structure...*", p.18)

is expected to undergo certain changes. The reduction of gas consumption and decreased GDP energy intensity will impact not only the final energy consumption, but also electricity generation and transmission sector. In particular, due to this, electricity share generated by TPP, CHP and isolated generating stations (IGS) will decrease, while the share of nuclear power and hydropower will grow due to construction of new NPP units, upgrading of existing facilities and construction of new ones at domestic PSP. Electricity export volume is expected to reach approximately 8-10 bln. kW*h.

Electricity Production Structure in Ukraine in 2012 and 2020, *%*

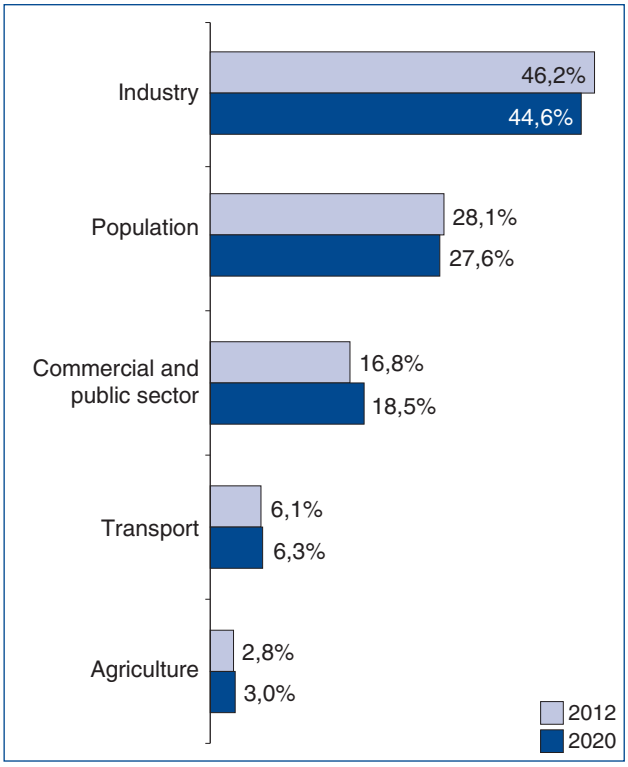


The share of CHP in the structure of electricity production is expected to decrease due to an increase in the overall equipment efficiency coefficient. The growing demand for district heating, which will be cheaper for consumers than using natural gas for heating and water heating, – will be met by means of using energy efficient technologies and reduction of thermal power losses in the process of its transmission to consumers. It is reasonable to partially readjust CHP to use coal instead of natural gas and residual oil, as well as to increase the use of solid fuel boilers, primarily, bio-boilers.

The decrease of GDP energy intensity for 20% in 2020 demands a significant reduction of FEC, which in 2020 must be around 10% lower than the 2012 level. FEC structure has to be transformed towards using technologically efficient energy resources.

The demand for electricity from end users by 2020 will increase insignificantly – by not more than 10%. This can be explained by increasing prices for this type of energy both, due to the dominating trend for increase in global and domestic prices for primary energy resources, and due to reduced cross-subsidies in Ukraine. On the other side, using electricity, primarily in industry and commercial sector, allows to reduce energy intensity of domestic products. As seen in diagram "*Structure of Electricity Consumption by End Users...*", consumption structure is not expected to undergo significant changes either.

Structure of Electricity Consumption by End Users in Ukraine in 2012 and 2020 *%*



Optimisation of Ukraine's energy balance until 2020 will be conducted at the expense of reducing the use of imported natural gas through reducing energy intensity of GDP. Economic benefit from this is greater compared to investments in replacing natural gas by other energy resources.

Energy intensity decrease is to take place through improvement of technologies, installation of new and decommissioning of old equipment, changing industrial equipment loading parameters, as well as through structural shifts in economy – proportion change of types of economic activity with different energy intensity and different rate of development. As opposed to this, the change of GDP energy intensity without a radical change of economy structure will require large financial investments with a rather long pay-back period. Therefore, structural optimisation of economy is an important foundation for reducing energy intensity of GDP.

4. ENERGY NETWORK INTEGRATION THROUGH COOPERATION WITH EU

Integration of Ukrainian gas and electricity markets into EU energy space is possible and appropriate on the basis of Ukraine's membership in the Treaty establishing the Energy Community and the Association Agreement between Ukraine and EU, as well as fulfilment of the related requirements, such as implementation of the EU legislation and regulations, restructuring market environment and developing trading instruments in support of effective competition. The fundamental element of such integration is legal and regulatory compatibility. Ukraine, represented by authorised economic operators, and having acceded as an observer, has to increase the degree of its integration in the European Network of Transmission System Operators for Gas and Electricity – ENTSO-G and ENTSO-E, the Agency for the Cooperation of Energy Regulators (ACER), Gas Infrastructure Europe (GIE). With support of European institutions, Ukraine has to implement the Third EU Energy Package and, subsequently, European Network Codes.

Participation in meetings of the Gas Coordination Group (as an advisory body to the European Commission) in the frame of Ukraine's membership in the Energy Community Treaty should take place on a regular basis with inclusion of Ukraine in the implementation of the Regulation on Security of Gas Supply in the EU.

Ukraine is facing the need to change the existing status of the GTS as the basic element of the former Soviet and now Russian system of gas export to Europe. This is conditioned by challenges from both Russia – construction of bypass non-transit gas export systems, and the EU – liberalisation, infrastructure integration and homogenisation of the gas market in Europe.

Ukraine's GTS and UGS systems have to be flexibly configured in order to use new possibilities that will emerge in Europe in connection with LNG supplies from South America and other regions of the world. As a more distant prospect, additional resources are expected to appear in the European gas circuit from the Caspian region, Central Asia, Iran and Norway's sector of the Arctic seas. European gas market will noticeably benefit from solving the problem of unconventional gas extraction, as well as European programmes of decarbonisation.

Given Ukraine's membership in the Treaty establishing the Energy Community, it is necessary to transform our gas transportation infrastructure into a flexible system of secure supply for Ukraine and Central Europe. This should allow for the use of Ukraine's GTS to transit Russian gas to the EU and for reverse gas supplies from Europe, as well as gas storage, its strategic reserve and gas trading operations in the East-European gas hub.

Depending on the progress achieved in implementing Ukraine's legal obligations, the next step can be the integration with the power market of Moldova, which will allow to exploit the potential for the establishment of back-to-back facilities for larger exchanges of energy and, at a later stage, integrate with the ENTSO-E synchronised power system.

Ukraine, on the basis of its membership in the Treaty establishing the Energy Community, has to take part in the general European or regional (in the format of Visegrád Group) solidarity mechanism, if any are to be created. Solidarity means providing practical assistance for reducing vulnerability, as well as in the situation of a sudden disruption of energy supply. The purpose of such participation is to guarantee a minimum level of gas supply in case of emergency situations.

Ukraine is ready to participate in creating such European energy solidarity mechanisms. The country can become a contributor to this mechanism through our system of UGS, on the basis of which a Strategic gas reserve can be created for the Central and Eastern Europe.

In order to prevent corruption and create an attractive investment environment, EITI mechanisms in the field of gas transportation can be used.

5. FUNCTIONAL AND SECTORAL TASKS OF NES 2020. ACTION PLAN

5.1. CREATING AN ENERGY-EFFICIENT SOCIETY

Energy Conservation and Energy Efficiency

The main lines of action to improve the energy efficiency of Ukraine's economy are to be the following:

- improving energy efficiency in the energy production and transformation sector, primarily in combined heat and power industry and district heating, through technical and technological modernisation;
- improving energy efficiency in energy supply sector, primarily in heat and electricity transportation and distribution systems, through technical and technological modernisation, as well as concept-based revision of energy supply schemes taking into account the advances in decentralised energy supply, particularly through the use of RES and management of energy use;
- reducing energy intensity in the manufacturing industry;
- reducing energy consumption in households and commercial/institutional sector for the purposes of heating through increased energy efficiency of residential and public buildings, as well as increased energy efficiency of heating appliances.

Implementation of structural changes in economy will have a decisive influence on energy efficiency level of the economy as a whole. However, measures of general economic nature must also be implemented, which require separate analysis and development of respective structural economic changes in the frame of country's economic strategy, including the following:

- restructuring the economy through reducing the share of resource and energy intensive sectors in the GDP structure and a corresponding increase in services sector and industries (mechanical engineering, consumer goods industry, small-scale chemical manufacturing, etc.) with low energy intensity of the final product;
- extension of technological chains in existing resource and energy intensive sectors in order to produce higher value-added products creating more added value per unit of resources/energy;
- increasing resource and energy efficiency of existing resource and energy intensive industries through technical and technological retrofitting.

Given the current state of energy efficiency, the following steps are to become the main tasks for the society in general and for separate industry sectors during the defined time-period of the strategic plan (until 2020).

A. For the Society in General

Increasing energy efficiency is on the list of Ukraine's international obligations under the Energy Community membership. These obligations are defined as national targets to reduce the total final energy consumption (by 9% in 2020, compared to the average consumption in the reference period – 2005-2009), as well as to introduce in the national legislation certain European directives on energy efficiency (Directives 2006/32/EC, 2010/31/EU, 2010/30/EU, 2012/27/EU).

Energy conservation cannot be a self-sufficient tool to get energy consumers interested in saving energy resources. Household and industrial consumers in most cases have their own specific goals and objectives, which are often not connected to the issue of sparing use of energy resources.

It is necessary to develop people's responsibility regarding energy efficiency and solve the problem of insufficient awareness of energy consumers about the benefits of sparing use of energy, existence of mechanisms to encourage their interest in energy conservation and general benefits for energy-saving domestic and business behaviour. Different mechanisms of disseminating information about the benefits of energy conservation should be introduced: conducting energy audits on the level of individual businesses, houses, labelling household goods regarding their energy performance, training programmes, advertising and public outreach.

B. For Industry

The country has make ensuring equal competition conditions for all businesses its primary task. In the context of high prices for energy resources, competition will stimulate businesses to introduce technical and technological innovations in order to optimise operating and capital costs, including energy resources costs. For further stimulation of implementation of such measures, the state has to use a system of financial, monetary, amortisation and other benefits and preferences.

The largest reserves in terms of energy efficiency increase are in the combined heat and power industry (reducing specific costs for about 30%, or 7 mln. toe/year with production volume at the level of 2013), iron and steel industry during production of cast iron (reducing specific costs for about 25%, or 3.5 mln. toe/year with production volumes at the level of 2013) and steel production (reducing specific costs for about 70%, or 1.1 mln. toe/year with production volumes at the level of 2013), as well as in chemical industry during manufacturing of ammonia (reducing specific costs for about 25%, or 1.1 mln. toe/year with production volumes at the level of 2013).

For realisation of this energy conservation potential investments are required in the following amount:

- TPP and CHP – approximately, 500 bln. UAH;
- iron and steel industry – approximately, 200 bln. UAH;
- chemical industry – approximately, 100 bln. UAH.

This energy saving potential cannot be realised in full within the specified period (until 2020), because of the long term of project, construction and assembly works in these industries. In addition, there are systemic or planning restrictions, as it is appropriate to build most of these facilities in the areas of existing objects and for their replacement. Therefore, at the planning stage such restrictions must be taken into account, and predictive economy and cost evaluations are to be adjusted accordingly.

C. For Private Households

The basic step is to gradually bring prices/tariffs for all energy resources for households to market levels. This should happen in accordance with the approved schedule, of which all citizens are to be informed, so that they can plan their expenses. Also, a 100% percent metering of all energy resources should be ensured. Increased tariffs are to be compensated for through reduction of absolute energy consumption level of households and optimisation of fuel mix. To implement energy conservation measures, increase energy efficiency and optimise fuel mix on the level of households, it is necessary to introduce a national monetary programme of their financing (loans, compensation of bank interest on commercial banks loans, shared financing, partial reimbursement of costs, etc.) and provide fiscal incentives to individuals.

The main measures to reduce energy consumption in households are measures to increase thermal resistance of frame structures in buildings (thermal insulation of walls, roofs and basements, replacement of windows and doors), replacement and/or installation of energy efficient equipment (furnaces, boilers, heat recuperators, automatic control systems, etc.), replacement of light sources (for fluorescent and LED sources), replacement and/or installation of energy efficient household appliances (refrigerators/freezers, dishwashers and washing machines, etc.).

Implementation of these measures will allow for at least 60% (or 14 mln. toe/year) reduction in household energy consumption.

D. For Public and Commercial Buildings

The list of main measures for energy consumption reduction in public and commercial buildings generally coincides with measures for households.

Implementation of these measures will allow for at least 60% (or about 2 mln. toe /year) reduction in public and commercial buildings energy consumption.

For realisation of this energy conservation potential in public and commercial buildings, investments are required in the amount of approximately 100 bln. UAH.

E. For District Heating Systems

Measures to improve energy efficiency in district heating systems must comply with plans to reduce energy consumption in private, public and commercial buildings connected to these systems. After these measures have been implemented at the consumer level, the burden on energy sources in district heating systems will be reduced at least by half.

The main measures to reduce energy consumption in district heating systems must be the following:

- replacement of main heat-generating equipment;
- replacement of pipes with preinsulated ones;
- waste heat recovery;
- technological processes heat recovery at industrial enterprises;
- modernisation of heat supply stations;
- using variable frequency drive for pumping and other electrically actuated equipment.

In connection with increasing prices for primary energy resources, it is necessary to re-evaluate the technical and economic parameters of long-distance heat transfer projects from large power facilities (TPP and NPP) and make a decision about the practicability of their realisation.

Implementation of these measures will allow to reduce specific energy consumption by district heating systems for at least 30%. The amount of investment necessary for realisation of this potential for increased energy efficiency is to be defined. According to preliminary total estimates, it can come out at not less than 200 bln. UAH.

RES Development

The main focus of action for the next five years regarding expanded use of RES in Ukraine should be the review of state policy of RES use stimulation in order to improve its cost-effectiveness. It should lead to a shift of focus in state policy from the production of electricity by large installations that use primarily solar and wind power, towards direct substitution of fossil fuels (mainly natural gas), RES and production of electricity by low-power installations. In order to reach the above targets, it is necessary to:

1. Apply regulatory and stimulating state policy mechanisms for the introduction of RES-using technologies that have competitive advantages over the fossil fuel based technologies. This means, first of all, replacement of natural gas with resources of biological origin (wood biomass, agricultural biomass, biogas, etc.) in district and individual heating systems. In cases, where it is justified, – with simultaneous production of heat/cold and electricity (cogeneration and trigeneration).

It is estimated that the use of biomass in district heating and in the public sector can help reduce natural gas consumption for 1.2 bln. cu. m/year and produce up to 1.2 bln. kW*h of electricity until 2020.[1] Required investment amount is approximately 15 bln. UAH.

2. Develop and implement mechanisms to encourage the use of RES by private households (individuals). First of all, such mechanisms should be aimed at substituting natural gas used for heating, domestic hot water (DHW) and electricity supply in private homes. The most promising RES in this sector include solid biomass (combustion in heating boilers), environmental energy (aerothermal, geothermal and hydrothermal energy, use of heat pumps) and solar energy (use of solar collectors and photovoltaic converters). The main mechanisms to use for stimulation of RES development in this sector are: monetary instruments (interest-free loans, preferential targeted loans, partial compensation of expenses, partial or complete interest coverage on targeted loans from commercial banks, etc.) and tax incentives.
3. Review current legislation in the part of introduction of effective "green tariff" rate for new facilities using RES, which will provide investors with a standardised rate of cost-effectiveness, ensuring protection from unduly increased financial burden on consumers and impossibility of receipt of super-profits.

Fundamental Algorithm of Movement and Legal Basis

It is proposed to reach the set goals according to the following schedule (with appropriate changes to legal acts as defined below):

- development, approval and notification of all consumers of the plan for stage-by-stage abandonment of direct and cross-subsidisation of prices/tariffs for all primary (including, natural gas) and secondary (electricity) energy forms with their gradual adjustment to the economically justified level for all categories of consumers ("Fair Energy Prices" plan);
- implementation of mitigation measures for the "Fair Energy Prices" plan, aimed at promoting RES use through monetary instruments, tax incentives, and complying with standards that complement mitigation measures aimed at promoting the reduction of energy consumption;
- introduction of amendments to legal acts regulating the establishment of the "green tariff" for new facilities that use RES;
- development and approval of the plan for stage-by-stage abandonment of direct and cross-subsidies of prices for all primary and secondary energy forms with their gradual adjustment to the economically justified level;

[1] Current state and prospects of bioenergy development in Ukraine. – Analytical note No.9, Bioenergy Association of Ukraine (BAU).

- finalisation and adoption of the National Action Plan for Renewable Energy for the Period Until 2020 (in compliance with Directive 2009/28/EC);
- development of a Work Plan for implementation of the National Action Plan for Renewable Energy for the Period Until 2020;
- development and implementation of a Legal Provision Work Plan for realisation of state policy for RES use development.

5.2. ENSURING ENERGY SELF-SUFFICIENCY

Minimising Gas Import Through the Development of Own Resource Potential, and namely:

- increasing the volume of exploration drilling, primarily, deep-hole drilling in the Dnipro-Donets depression;
- increasing production drilling in produce fields that are being developed;
- application of extraction stimulation technique at existing deposits;
- construction of boosting compressor stations at existing fields with residual resources;
- development of shallow shelf of the Black Sea (Odesa and Bezimenne fields).

Creating a Strategic Reserve:

- oil and petroleum products reserve, based on the 90-day standard and mixed management system;
- natural gas reserve, on the basis of Ukrainian UGS;
- nuclear fuel reserve, with consideration of security issues and possibilities for diversification of its supply;
- coal reserve, taking into account thermal generation needs and possibilities of production and storage in the time of external aggression.

Diversification of Supply:

- increased reverse supply from the EU;
- Ukraine's initiating and active participation in creating an East-European gas hub;
- construction of own LNG terminal and/or arranging for LNG supply from nearby existing terminals or LNG terminals in the final stages of construction (Klaipeda, Lithuania; Swinoujscie, Poland);
- export coal supply (until the mines in Donbas resume work).

5.3. OPTIMISATION OF BALANCE OF NATURAL GAS CONSUMPTION

The balance of natural gas consumption must be changed within the five-year period through systemic measures for reduction of gas consumption in the industrial segment, DHC and the household segment.

The Volume of Natural Gas Consumption in Ukraine, mln. cu. m

	2010 (real)	2011 (real)	2012 (real)	2020 (expected)
Population	17 344,4	17 264,0	17 071,0	13 500,0
Industry	15 974,1	15 212,2	23 629,0	17 200,0
DHC	11 785,0	10 627,9	8 150,0	5 500,0
Public institutions	927,1	909,8	930,0	800,0
Total	46 030,6	44 013,9	49 780,0	37 000,0

The main emphasis should be placed on reducing industrial gas consumption through optimising and upgrading chemical and iron industries with high gas intensity production, increasing energy efficiency of gas consumption in households, and partial substitution of gas with electricity.

5.4. IMPLEMENTATION ALGORITHMS

Legal Basis

Basic direction is elaboration of draft legislation aimed at implementing in Ukraine the EU directives and regulations in line with Ukraine's membership in the Energy Community Treaty.

Taking this into account, the priority is to develop and implement the following:

- draft amendments to the current Law of Ukraine "On the Principles of Natural Gas Market", while bringing it in accordance with the requirements of the 2nd and 3rd EU Energy Package;
- draft Law of Ukraine "On the National Committee for State Regulation in the Energy Sector" according to the requirements in the Treaty establishing the Energy Community and the best EU practices;
- draft Network Code (gas) and Grid Code (electric power) in line with corresponding Eurocodes;
- regulations for implementation of electricity market in Ukraine;
- draft amendments to the Subsoil Code regarding transparency in extractive industries;
- develop and adopt the law on protection of energy installations and facilities;
- develop and adopt the law on strategic fuel reserve;
- legal acts for adjustment of Eurocodes for gas and electricity (as soon as they are adopted in the EU).

Gas Sector

Implementation of the current Law of Ukraine "On the Principles of Natural Gas Market" and regulatory and legal framework, in accordance with the 2nd and 3rd EU Energy Package:

- reorganisation of NAK Naftogaz Ukrainy with separation of the GTS as an independent company together with UGS, and further creation of companies "Main Gas Transmission Pipelines of Ukraine" and "Underground Gas Storages of Ukraine" on their basis. Such economic entities are to be created by the Cabinet of Ministers of Ukraine in line with the Law of Ukraine as of 14 August 2014 No.1645-VII "On Amendments to Some Ukrainian Laws on the Reform of the System of Management of the Unified Gas Transportation System of Ukraine" with the purpose of attracting investment for modernisation of the GTS of Ukraine, including underground storages: operator of the Unified Gas Transportation System of Ukraine; operator of the Underground Gas Storage with Ukraine's state share not less than 51% of the statutory fund of each of them, with the purpose of involving investment of EU and US companies. Plan for privatisation of up to 49% of statutory fund shares of the named above operators through competitive bidding;
- transformation of NAK Naftogaz Ukrainy from the company that combines commercial activity with state management functions into a holding structure with functions limited to the level of organisational powers to hold shareholders meetings and prepare annual reports; transfer of all commercial and industrial tasks to subsidiaries;
- reduction of tax burden on gas production companies through optimisation of rental payment rates, which are to be set impartially, with the help of a developed methodology based on international experience;
- transition to market gas prices for all consumers with execution of provisions of the Memorandum of Understanding on the Social Aspects of the Energy Community regarding protection of socially vulnerable consumers;
- modernisation of the GTS of Ukraine and the UGS system;
- implementation of transparency mechanisms at all stages of industry operation, from production of gas to supplying it to consumers through gas distribution networks.

Nuclear Power Complex

Until 2020 the share of nuclear power generation at NPP should be at 46-50% of the total power generation. It is also expected that the utilisation factor of installed NPP units capacity will increase to 76-78%. Creation of an adjustment range for WWER-440 reactors, which will increase the daily additional adjustment capacity for 80 MW on workdays and for 400 MW on weekends.

To ensure stability of operation and development of the nuclear power complex, it is necessary to:

- increase the share of NPP in the energy balance by expanding the transmission capacity of power lines for NPP power output and reconstruction of open 750 kV Rivne NPP, Khmelnytskyi NPP and Zaporizhzhya NPP distribution facilities;
- restore the mechanism foreseen by the Law of Ukraine "On Regulation of Issues Related to Ensuring Nuclear Safety" for accumulation of a financial reserve to prepare for the future decommissioning of NPP units;
- prohibit on the legislative level the use of financial reserve funds not as intended by the central executive power body, which implements state policy in the field of treasury servicing of budget funds (to prevent the use of funds by legal entities other than the operating entity);
- prolong the term of execution of the Comprehensive (Summary) Programme for Increasing Safety Level at NPP Units for the Period of 2017-2022;
- identify the prospects for corporatisation of DP NAEK Energoatom (State Enterprise National Nuclear Power Generating Company "Energoatom") with controlling stake remaining in state ownership.

6. TRANSFORMATION OF ENERGY MARKETS

Ensuring fast reforms and efficient functioning of competitive and transparent markets for electricity, heat, gas, oil and petroleum products, biofuel, and coal, with consideration of adverse factors (including external aggression) must be a permanent task for public institutions. Tariffs for energy resources, in particular, natural gas and electricity, must be brought to market level for all categories of consumers, including population. For the most vulnerable categories of population, a mechanism of subsidies must be introduced for partial compensation of utility payments. Until the beginning of 2017, the change of tariffs for energy resources to their market level must be complete. Introduction of fair tariffs for energy resources will become an important instrument for increasing energy efficiency of society in general, and will ensure the payback of economically justified operating expenses of local energy resources producers and suppliers.

6.1. GAS SECTOR REFORM

Creating a Gas Market and Regulatory Environment

The purpose of reforming gas sector is to create an efficient gas market and regulatory environment in Ukraine compatible with the gas market and regulatory environment of the EU. The goals of the reform are:

- to create a competitive consumer-oriented market;
- to reduce specific indicators of gas consumption to the level of Central-Eastern European countries;
- to increase domestic gas production from both conventional and unconventional (in the future) sources;
- to integrate national gas transportation infrastructure into the European one;
- to transform GTS transit potential currently oriented in one direction (East-West) to a poly-oriented flexible secure supply system;
- to attain a high level of transparency in the work of gas production, transportation and distribution companies.

To reach these goals, it is required to:

- implement in full the 2nd and 3rd EU Energy Packages in accordance with Ukraine's membership in the Treaty establishing the Energy Community, including institutional aspects and independence of the national regulator;
- realise a complex of measures for gas substitution and gas conservation;
- implement a price reform and attract investment in domestic gas production;
- implement stimulating tax legislation;
- reorganise NAK Naftogaz Ukrainy and its subsidiaries according to the best EU practices;
- optimise and retrofit the GTS of Ukraine;
- implement EITI standards.

Third parties aim at implementing projects of creating non-transit gas transmission systems. As a result, transit function of Ukraine's GTS in supplying gas to the EU may lose its importance.

Ukraine has a possibility to:

- perform organisational transformation of GTS according to the principle of business unbundling;
- change the scheme of acceptance and transfer of transit gas volumes from western to the eastern border of Ukraine with assistance of the European Commission;
- devalue the role of the main gas supplier using the "zero transit – zero procurement" principle;
- optimise GTS capacities according to the predicted decrease of demand for its services from those European consumers, who participate in or support necessary projects without waiting for their full implementation.

Gas Sector. Basic Tasks

Short-term (2015-2016):

- to conduct an independent audit of hydrocarbons production sector (international audit of reserves and resources, transparent public inventory of all production wells and publication of information on their owners, data on the wells and well rates on the special website of an on-line government portal);
- to review licensing policy in the field of search and exploration of hydrocarbon deposits for creating a transparent competitive environment, reduction of bureaucratic barriers in obtaining licenses, and ensuring proper state control over the use of licensed areas by investors;
- to establish total accounting and control of movement and use of gas according to the principle "from the well to the burner";

- to discontinue illicit and unaccounted for extraction of energy resources;
- to drastically reconsider contractual relations with the RF through tripartite EC – Ukraine – RF negotiations;
- to involve, using a tender procedure, independent European specialists as advisors to the management of state energy companies;
- to ensure really independent functioning of energy regulating authority and the antimonopoly agency according to EU legislation and best practices, while increasing the powers and capabilities of the regulatory authority through giving it full financial autonomy and power regarding tariffs;
- to reform oil and gas sector with separation of infrastructural objects into independent entities, while preserving their state control and managing;
- to install gas metering stations on the border with Russia for the purpose of moving there gas custody transfer points;
- to study the issue and make a decision regarding the reasonability of using Floating Storage Regasification Unit – FSRU (floating unit for storage and regasification of natural gas) for LNG supply to Ukraine from the Black Sea direction and construction of a gas pipeline to connect FSRU to the GTS of Ukraine;
- to initiate creation of a multilateral Gas Crisis Early Warning Mechanism through establishing a transparency mode of cross-border gas flow movement (instrumental control of physical parameters);
- to implement EITI standards through licensing mechanisms;
- need for a more targeted definition of socially vulnerable gas consumers in line with the Energy Community recommendations, as well as for an efficient mechanism of targeted compensations for this category of consumers;

Mid-term (until 2018):

- to complete the implementation of EU Energy Packages under the obligations of the Treaty establishing the Energy Community;
- to regain state control over shelf assets in the Black Sea (in the event of favourable external conditions);
- to retrofit Ukraine's GTS in cooperation with the EU;
- to transfer to the European gas accounting system based on its qualitative indicators (heat equivalent);
- to create a competitive environment in domestic energy markets, open them for European companies;
- to construct a Polish-Ukrainian interconnection in order to expand opportunities for receiving gas using the reverse circuit (including, from the terminal in Świnoujście on the Baltic coast of Poland);
- to integrate a group of western Ukrainian UGS into the secure supply system of Visegrád Group countries and the EU in general.

Long-term (until 2020 and on):

- to implement gas substitution programmes where it is economically beneficial and technically possible, on the basis of using bioenergy products, coal (coal-water mixture), production of synthesis gas;
- to continue attracting world's leading companies to the development of the Black Sea shelf and development of natural gas deposits from unconventional sources;
- to create a Strategic Gas Reserve of Energy Solidarity on the basis of Ukraine's UGS;
- to create East-European gas hub or join an already existing marketable gas hub;
- to create infrastructural possibilities for LNG import through cooperation with third countries;
- to cooperate with Poland and Norway regarding possible future projects on diversification of gas supply to Central-Eastern Europe;
- to adjust GTS capacities in the frame of the EU decarbonisation programme.

Application of European energy legislation within Ukrainian legislation through the mechanism of the Treaty establishing the Energy Community can significantly decrease Ukraine's vulnerability to permanent attempts of the RF to politicise interstate relations in the sphere of energy supply, and participation in the general European market will allow to decrease the non-transparency of domestic markets, first of all, the gas market.

6.2. ELECTRIC POWER INDUSTRY REFORM

New Market Model

Nuclear sector will remain the basis of power generating industry. To ensure fuel independence of Ukraine's nuclear power sector, it is important to construct a nuclear fuel production plant involving foreign US and EU companies.

In the new electricity market model, timely and full payment for the electricity produced by NPP should be ensured. During the development of market reform, it is necessary to take into account the "place" of nuclear generation, which works mainly in the "basic" part of

the load schedule. Besides, the influence of subsidy mechanisms must be minimised on the revenue from electricity sales by NAEK Energoatom.

During transition to the new electricity market model, the following mechanisms must be developed: market, capacities, new regulatory environment, specialised funds that will ensure a guaranteed accumulation of funds required for reliable operation of NPP in the new liberalised market conditions.

Creating a transparent liberalised fuel market will allow to support the modernisation of thermal generation with a gradual transfer of its operation to more modern technologies.

In order to perform these tasks, it is necessary to:

- improve funding mechanisms for radioactive waste management;
- review the National Target Environmental Programme of Radioactive Waste Management to create a complete cycle of radioactive waste processing from their production until disposal;
- provide funding for the creation of network facilities for radioactive waste management at the expense of Radioactive Waste Management Fund and operating entity funds;
- adopt regulatory and legal acts that will create the basis for the work of the new electricity market, including separation of transfer, transportation and supply of electricity.

Electric Power Sector. Basic Tasks

Short-term (2015-2016):

- make changes to the Law of Ukraine "On the Principles of Electricity Market of Ukraine" in order to eliminate mechanisms of subsidies at the expense of NPP and HEP revenue, and adopt a decision on restructuring DP NEK Ukrenergo;
- extend the operation term of NPP units No.2 at South Ukraine NPP and No.1 and 2 at Zaporizhzhya NPP;
- complete the programme of experimental-industrial use of nuclear fuel (fuel assemblies) in accordance with the Executive Agreement between the Government of Ukraine and the Government of the United States of America on implementation of Nuclear Fuel Qualification Project for Ukraine as of 5 June 2000 and the contract between DP NAEK Energoatom and Westinghouse company;
- conduct an independent audit of the nuclear sector (public transparent tariff setting procedure, publication of information about conducted tenders, execution of works);
- adopt a law on separation of transfer, transportation and supply of electricity;
- need for a more targeted definition of socially vulnerable electricity consumers in line with the Energy Community recommendations, as well as for an efficient mechanism of targeted compensations for this category of consumers.

Mid-term (until 2018):

- extend the operation term of NPP units No.3 at Zaporizhzhya NPP and No.3 at Rivne NPP;
- ensure supply and industrial use of nuclear fuel from Westinghouse company for the annual recharge of 3 WWER-1000 NPP units (i.e. 15 fuel lots);
- implement the required legal provisions for electricity market and the development of the competitive market environment including required infrastructure for full functionality (at least in the bilateral, balancing, day-ahead and ancillary services domain);
- develop and adopt secondary legislation required for operation of the competitive trading platforms and corresponding supporting facilities (for monitoring, settlement, transparency, etc.);
- restructure the transmission system operator Ukrenergo and redistribute its functions according to the determined restructuring model, along with the required adjustment of the Laws in line with the requirements of the certification procedure of Energy Community Secretariat;
- complete the pricing reform aimed to bring the regulated prices to cost-recovery level and sustainable level of support mechanisms;
- restructure the distribution and supply domain to the level required for the entry of new (independent) suppliers of electricity for all categories of end-users on all levels;
- develop and apply supplier switching rules and support/protection mechanisms (such as "Universal supplier" or "Guaranteed Supplier or Supply of Last Resort" mechanisms);
- integrate power system of Ukraine with the power system of Moldova, including deployment of cross border transmission capacities, which would ensure operation of day-ahead markets, market coupling and balancing markets.

Long-term (until 2020 and on):

- extend the operation term of the following NPP units: No.1 at Khmelnytskyi NPP from 2018, No.3 at South Ukraine NPP from the second half of 2019, No.4 at Zaporizhzhya NPP from 2018, No.5 at Zaporizhzhya NPP from the second half of 2019, No.6 at Zaporizhzhya NPP from the second half of 2026, Khmelnytskyi No.2, Rivne No.4 after 2030;
- construct new NPP units (South Ukraine NPP, Zaporizhzhya NPP, Khmelnytskyi NPP) using modern technologies, which comply with regulatory and legal requirements of IAEA and Euratom;
- complete formation of all levels of competitive market and establish a market monitoring platform;
- complete the process of synchronisation with ENTSO-E.

Algorithm of Movement and Legal Basis

Bring in accordance with the 3rd EU Energy Package of the Law of Ukraine "On the Principles of Electricity Market", as well as regulatory and legal framework →

→ Reorganise DP NEK Ukrenergo and DP Energorynok: execute legal separation of companies on the basis of functional principle of transfer, distribution and supply of electricity, create market infrastructure →

→ Make a transition to reasonable market prices for electricity for all consumers with execution of provisions of the Memorandum of Understanding on the Social Aspects of the Energy Community regarding protection of socially vulnerable consumers→

→ Retrofit and increase generation manoeuvre capacities and implement a target programme of re-equipment and creating efficient cogeneration + liberalise coal market.

The foundation is elaboration of draft legislation aimed at implementing in Ukraine the EU directives and regulations in accordance with Ukraine's membership in the Energy Community Treaty. Taking this into account, the priority is to develop the following:

- draft amendments to the Law of Ukraine "On the Principles of Electricity Market in Ukraine" and bring it in accordance with the requirements of the 3rd EU Energy Package;
- draft Law of Ukraine "On the National Commission for State Energy and Public Utilities Regulation" according to the requirements in the Treaty establishing the Energy Community and best EU practices;
- new draft law on cogeneration, taking into account the requirements of the EU, the Grid Code, Market Rules and other regulatory and legal acts in the electricity market;
- improved legislation through amending the Commercial Code of Ukraine, laws of Ukraine "On Public Procurement", "On the Commodity Exchange", "On the Licensing System in the Sphere of Economic Activity" and others, in order to liberalise the coal market and review subsidies system in line with WTO requirements.

Task Execution Paths:

- during transition to the new electricity market model, investment mechanisms must be developed (capacity market, regulated agreements, specialised funds) that will ensure a guaranteed accumulation of funds required in the new operating conditions;
- consider attracting private capital for construction of new HEP, PSP and NPP facilities through creating mechanisms for public-private partnership, joint ownership, etc.;
- adopt European regulations for supporting efficient distributed co- and trigeneration (Directive 2004/8/EC).

6.3. REFORM OF COMBINED HEAT AND POWER INDUSTRY AND COAL SECTOR

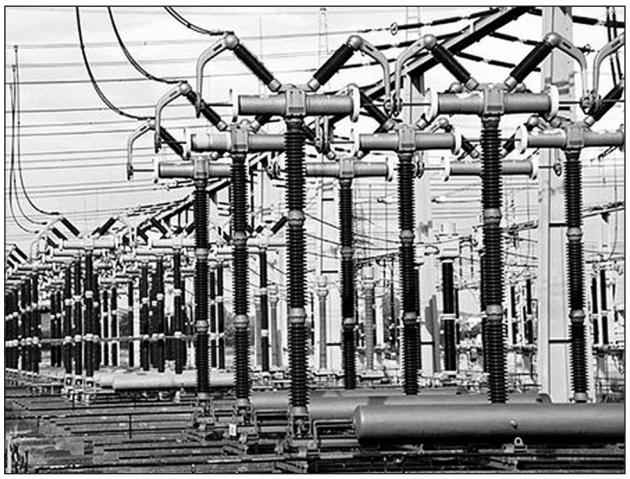
Creating an Efficient Market and De-monopolisation

The reform of electric power and coal sectors aims to create an efficient market, as well as eliminate monopolies and reduce subsidies of the coal sector. Ukraine's electric power market must integrate with the European one, and the coal sector has to really shift to market principles of operation. The goals of the reform are:

- ensuring security of supply of electricity and coal;
- closing the unprofitable and destroyed mines;
- integration with ENTSO-E;
- liberalising energy market;
- providing consumers with real rights to choose suppliers according to the most favourable conditions of reliable supply and prices.

To reach these goals, it is required to:

- implement in full the 2nd and 3rd EU Energy Packages in accordance with Ukraine's membership in the Treaty establishing the Energy Community;
- conduct the audit of all available mine assets;
- implement the complex of measures for introduction of market mechanisms;
- minimise cross-subsidisation practices;
- reorganise DP NEK Ukrenergo, DP Energorynok, create market institutions for establishing the electricity and coal markets, separate functions of transfer, distribution and supply of electricity in accordance with best EU practices;



- retrofit power plants, networks, introduce new technologies of coal extraction, close down the unprofitable mines;
- support the development of efficient co- and trigeneration that uses local fuel and RES.

Basic Tasks

Short-term (2015-2016):

- to create mechanisms for replacement of main and auxiliary TPP equipment;
- to adopt the programme of CHP rehabilitation and construction of efficient co- and trigeneration facilities;
- to develop a National Programme of Heat Provision;
- to continue reconstruction and rehabilitation of HEP equipment;
- to improve government protection and management of the state of waterworks, as well as protection of HEP in possible unpredictable situations;
- to create conditions for the development of small hydropower;
- to introduce the mechanism of stimulating regulation for the transmission and distribution companies starting in 2015;
- to construct new 750 kV power transmission lines for NPP power output;
- to conduct audit of the DP Vugillya Ukrainy (State Enterprise "The Coal of Ukraine") with publication of its economic activity results;
- to conduct independent international audit of the real physical condition of coal mines on the territory of Donetsk and Luhansk oblasts;
- to create and implement a programme of closing down the unprofitable mines taking into account the social consequences in the region;
- to prepare the transition to reduced subsidies of coal industry and creation of coal market.

Mid-term (until 2018):

- to realise the plan of integration with ENTSO-E;
- to organise operation of full-scale electricity market;
- to reduce cross-subsidies in electric power industry for not less than 70%;
- to transfer to the subsidies system in coal industry according to WTO and EU rules.

Long-term (until 2020 and on):

- to increase the potential of electricity export to EU markets;
- to begin construction of new NPP units;
- to increase capacities in hydropower generation and manoeuvre possibilities of the UPS of Ukraine for 10-15%.

Improving Legislation that Regulates the Electric Power Industry with Regard to *Acquis Communautaire* Requirements

The priority is the adoption of legal and regulatory acts aimed at implementation in Ukraine of EU directives and regulations in accordance with Ukraine's obligations under the Accession Protocol to the Treaty establishing the Energy Community, decisions of the Energy Community Ministerial Council and the requirements of the Association Agreement between Ukraine and the EU, in particular:

- make changes to the Law "On Electric Power Industry" in the part of "green tariff" introduction for new facilities using RES, which would provide investors with a standardised rate of cost-effectiveness, ensure protection from unduly increased financial burden on consumers and impossibility of receipt of super-profits;
- make changes to the Law "On Electric Power Industry" in the part of terminology definition and bring it in compliance with Directive 2009/28/EC;
- finalise and adopt a National Action Plan for Renewable Energy for the Period Until 2020 (in compliance with Directive 2009/28/EC);
- develop and approve a National Action Plan for Reduction of Pollutant Emissions from High-Capacity Combustion Plants (50 MW and over), in compliance with requirements in Directives 2010/75/EU, 2001/80/EC;
- make changes to regulatory acts on RES in order to bring them in compliance with Directive 2009/28/EC.

7. CREATING ATTRACTIVE INVESTMENT ENVIRONMENT

Creating a favourable investment climate is to be ensured foremost through creating competitive markets on the basis of transparent regulation according to European rules, integration of Ukraine's energy infrastructure with energy systems of EU countries, compliance with the rule of law principle and implementation of public-private partnership mechanisms.

Investment attractiveness of Ukraine's economy, especially its energy sector, will remain low, unless a complex of measures is implemented aimed at preventing the outflow of capital and returning the moved out capital. In this regard, it is appropriate to:

- introduce measures for de-offshorisation of energy industry through prohibiting the use of offshore ownership schemes and account settlements of energy and gas distribution companies (oblenergo, oblgaz companies);
- ensure restitution of financial assets that were being withdrawn from the Ukrainian energy sector for a long period of time and were accumulated in offshore accounts, through capital amnesty;

- introduce a transparent mechanism of state procurements;
- create favourable investment climate through mechanisms of state-private partnerships and transparent regulation based on European pattern;
- implement stimulating tax legislation;
- renounce the practice of budget assistance to natural monopolies through financial instruments.

Integration of Ukraine's energy infrastructure into European energy space can happen through the Visegrád Group regional energy platform (V4). The Visegrád Group expands the format of cooperation with its neighbours according to formula V4+. Integration with ENTSO-E and ENTSO-G. As a member of Energy Community, Ukraine will implement joint regulatory policy with EU countries, as well as the *acquis communautaire*.

8. IMROVEMENT OF MANAGEMENT, REGULATION AND STAFFING

Reform of energy management system requires a significant improvement of the quality of management decisions, transition from the sectoral principle of its structuring to functional, and expanded use of new computer technologies.

A new paradigm of state management and regulation must be implemented, which will significantly increase the role of the national regulator that is to set and control the rules of market operation. At the same time, the role of Ministry of Energy and Coal Industry has to be limited to coordination of NES 2020 and sectoral programmes implementation, as well as formation of energy balance and technical policy in the sector. Excessive functions of the Ministry of Energy and Coal Industry related to immediate intrusion in the work of separate entities and markets, redistribution of finance and resources flows, must be revoked, as they give rise to unfair competition and corruption practices.

Changing the principles of the energy sector management, liberalisation of markets, introduction of general energy accounting system, new technologies, innovative information, control and regulation systems – all require availability of professionals with appropriate training. The existing national system of training respective professionals is poorly adjusted to Ukraine's modern energy development needs. Without resolving personnel issues, implementation of NES 2020 will be greatly complicated. It is proposed to prepare a training programme for energy professionals taking into account the experience of training similar specialists in the EU, the US and Canada. The programme is expected to include:

- bringing training programmes and facilities at technical universities to conformity with the new needs;
- financial provision and staffing for respective training of teachers and professors;
- optimising the number of students to meet the needs of energy sector;
- measures for retraining specialists;
- students studying abroad and having internships in leading EU, US and Canadian energy companies.

NES 2020 requires not only the support for higher education capacities, it is also necessary to create efficient structures for scientific and technical research, design and consultancy services. Priority areas of scientific research that require support and commitment of the Government are:

- nuclear power security, reliability and longevity of power plants, structural material aging;
- management, storage and disposal of spent nuclear fuel and other radioactive materials, treatment of waste;
- technologies of renewable and local energy sources utilisation;
- co- and trigeneration, fuel elements;
- conservation of energy and energy efficiency, environmental aspects of energy industry;
- energy economics, optimisation of complex systems for design and management, optimisation of technological processes and their management, transformation of energy markets, energy security;
- operation of oil and gas industry equipment;
- protection of critical energy infrastructure.

APPENDIX TO THE NEW ENERGY STRATEGY OF UKRAINE UNTIL 2020: SECURITY, ENERGY EFFICIENCY, COMPETITION

State of Energy Sector of Ukraine

This NES 2020 appendix includes materials of general (reference) character, which provide a clearer idea about the state of energy industry of Ukraine. A special emphasis is placed on the issues of oil production and processing. In the mid-term and long-term perspective, these sub-industries require development and comprehensive retrofitting on the basis of new technologies.

1. Oil Production and Processing

State of the Oil Production Industry of Ukraine

Ukraine is one of the oldest oil-producing countries in the world. Since the beginning of industrial exploitation of domestic deposits in Ukraine, approximately 375 mln. ton of oil with natural gas liquids was produced (in the past 20 years – about 85 mln. ton). Total oil and natural gas liquids resources are 1,041.0 mln. ton (table "*Oil and Natural Gas Liquids...*").

Oil and Natural Gas Liquids Resources in Ukraine, mln. ton*

	Reserves	Resources
Oil	137	705
Natural Gas Liquids	69	336
Total	206	1 041

* Data of NAK Naftogaz of Ukraine.

In Ukraine, there are three known oil and gas bearing regions (Eastern, Western and Southern), hydrocarbon resources of which have been developed for 41% (including oil – for 33%). *Eastern region* contains almost 61% of oil reserves of Ukraine. In its territory 205 hydrocarbon deposits were discovered, 180 of which were included in the state balance. Deposits Lelyakivske, Hnidyntsivske, Hlynsko-Rozbyshevske, Buhrovativske, Kachanivske, as well as Prylutske, Okhtyrske, Radchenkivske and others are currently exploited.

Western region is mainly located in the Carpathian region. There are exploited Boryslavske, Dolynske, as well as Bytkivske, Oriv-Ulichnyanske, Blazhivske, Ripnyanske and other deposits. *Southern region* – encompasses Western and Southern Black Sea region, Northern Azov Sea region, Crimea, Ukrainian zones of the Black and Azov Seas. On the territory of the region 39 deposits were discovered, out of them – 10 oil deposits.

In the Eastern region, where most of the deposits were discovered after World War II, almost 75% of Ukraine's oil is produced, in the Western – a little over 20%. The remaining part is produced by the Southern region. Oil resources in each region have their differences by physical and chemical properties (table "*Comparison of Ukrainian Oil Resources*").

Oil production industry of Ukraine is represented by PAT Ukrnafta (PJSC "Ukrnafta"), 50% + 1 share of which

Comparison of Ukrainian Oil Resources*

Type of raw material	Density, kg/m^3	Mass fraction, %		Potential mass fraction of light oils, %		
		paraffin oil	sulphur	gasoline	diesel fuel	sum
Oil						
Eastern Ukrainian	825-892	0,01-5,4	0,03-0,79	9-34	26-39	34-69
Western Ukrainian	818-856	6-11	0,23-0,79	21-30	26-32	51-63
Natural gas liquids						
Poltava	732-760	0,04-0,17	0,03-0,10	51-54	40-44	94-95
Kharkiv	726	1,0	0,078	85	10	95
Black Sea	756	1,0	0,036	49-50	25-30	75-80

* Summary of Data from the Ministry of Energy and Coal Industry of Ukraine.

belong to NAK Naftogaz Ukrainy. Being a monopolist in the market, this company produces about 85% of all oil produced in Ukraine (over 70% of oil with natural gas liquids).

State balance includes 296 deposits, incl. 67 oil, 10 gas-oil and oil-gas, 51 oil-natural gas liquids, 70 gas and 98 natural gas liquids, the developed reserves of which (categories A + B + C_1) are 2.4 mln. toe (table "*Oil Characteristics...*"). In industrial exploitation are currently 236 deposits. Companies of NAK Naftogaz have currently developed reserves in the volume of 924 bln. cu. m of natural gas and 155 mln. ton oil with natural gas liquids. In 2007, NAK Naftogaz had 184 licenses for industrial development of oil and gas deposits and 158 – for geological exploration and pilot industrial development of mineral resources.

In 2007-2013, high rates of oil production decline were observed, first of all, due to insufficient investment in geological exploration and pilot drilling (diagram "*Oil and Natural Gas...*").

Problems of Oil Production Industry of Ukraine:

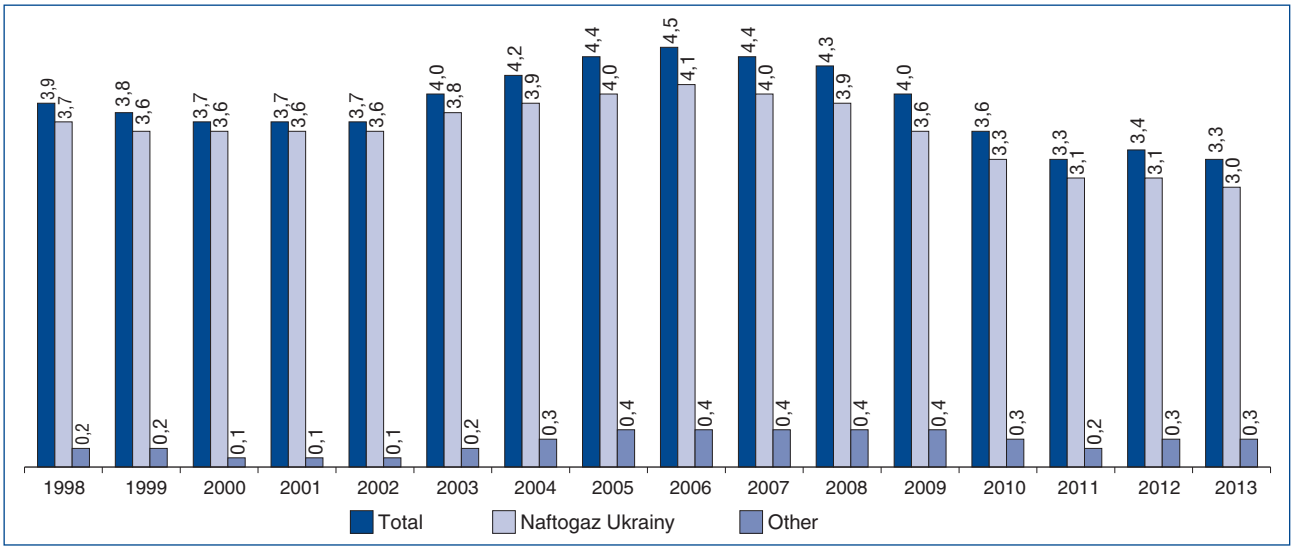
- *significant reduction of the volume of exploration* (from 425 thousand m in 1991 to 152 in 2010 and for 95 thousand m since 2005), *and reduction of the volume and efficiency of pilot drilling,* the volume of which since 1991 dropped from 343 to 143 thousand m (in 2005-2010 – for 108 thousand m). Exploration companies of NAK Nadra Ukrainy could not provide the development of resource base (the increment of reserves dropped from 43.3 to 4.55 mln. toe). In 20 years only one big field was discovered (Subotynske, approximately 65 mln. ton). Regarding other fields (88% of the developed ones), – their reserves are insignificant and due to great depth, low flow rate and small number of drilling wells cannot drastically influence the total production volume. The volume of exploration conducted in 2006-2011 at the expense of all funding sources was 5 times less than the necessary volume for stable replenishment of raw materials supply;

Oil Characteristics of Largest Ukrainian Oil Fields*

Oil Field	Location	Oil Occurrence Depth, km	Year of beginning of industrial exploitation	Initial Recoverable Reserves A+B+C_1, mln. ton	Oil Density, kg/m^3	Mass fraction of sulphur, %
Eastern oil and gas bearing region						
Lelyakivske	Chernihiv oblast	1,76	1964	52,4	815	0,23-0,27
Hnidyntsivske	Chernihiv oblast	1,78	1959	38,0	803-827	0,32-0,54
Hlynsko-Rozbyshevske	Sumy, Poltava oblast	3,70	1959	25,3	838-872	0,21-0,66
Buhrovativske	Sumy oblast	3,58	1976	20,9	840-868	0,8-1,0
Kachanivske	Sumy oblast	1,47	1960	16,8	811-868	0,2-0,5
Western oil and gas bearing region						
Boryslavske	Lviv oblast	…	1881	39,3	837-872	до 0,78
Dolynske	Ivano-Frankivsk oblast	1,40	1950	38,3	769-844	0,17-0,32

* Summary of Data from PAT Ukrnafta.

Oil and Natural Gas Liquids Production in Ukraine,
mln. ton



- *exhaustion of reserves at most fields, foremost basic, due to long-term exploitation* (from 30-40 to 100 and more years) *and write-off of reserves, availability of which has not been confirmed during industrial development*. Maximum production level (reached in 1972) – 14.5 mln. ton oil with natural gas liquids, was provided by production from six large fields, currently exhausted for 90-98%;
- *permanent deterioration of reserve structure* (for many years the development was conducted primarily in those places, where access to resources was easiest);
- *low reliability of raw materials basis*. For 20 years, new deposits were presented for industrial development with reserves of the lowest industrial category C_1, the reliability of predictions about which (the margin of error) could be 30-50%. From the extracted oil reserves, to this category belong 71% (about 105 mln. ton);
- *poor facilities and financial provision, as well as lack of specialists for exploration on the modern level*. Companies use primarily imported equipment, while technical specialists are being trained using obsolete Soviet equipment. Young geologists are totally unprepared for the real work;
- *there is no widespread use of advanced technologies and technical means of exploration and mining created by the oil and gas science of Ukraine*. Fixed capital investment per 1 ton of produced oil in Ukraine is at least twice lower than in the European countries. To ensure stable operation of the industry with an annual production of over 5 mln. ton of oil, from $0.5 bln. to $1.0 bln. is required annually;
- *inefficient state policy*. First, one-time withdrawal from subsoil users of big amounts of money at tenders for granting subsoil use rights actually reduces exploration investments for the same amount. Second, sometimes the rights to most promising areas are given to businesses, which do not have the material basis for production of hydrocarbons. Third, Ukrainian governments did not always fulfil the responsibilities of their predecessors.

High-Potential Investment and Innovation Areas in Oil Production Industry

The current level of oil extraction technologies from unconventional sources is only approaching large-scale development, so in the mid-term perspective unconventional hydrocarbons are not an alternative to conventional ones.

Ukraine has a powerful resource potential of hydrocarbons, but it must be actively and efficiently used. If, for example, we increase the volume of exploration drilling to the level foreseen by the National Programme "Oil and Gas of Ukraine until 2010", then by 2030 we can build up the explored reserves to over 150 mln. ton of oil and natural gas liquids. For this, companies of NAK Naftogaz need to annually commission for exploratory drilling 30 prospective areas, carrying out seismic operations at 40-45.

Key innovation areas of modern oil industry focus are:

- *oil field digitising*. What is meant, is a visual web-platform, through which companies can measure and monitor all data coming from the entire field;
- *Accessing the Previously Inaccessible*. Due to new stimulation techniques the volume of extraction of remote resources is significantly increased. Such techniques are: hydraulic and gas-dynamic (with carbon dioxide injection) formation fracturing; treatment of wells with reagents; reagents, hydro-impulse and vibro-streaming; nitrogen and impulse; electricity and water; electricity; slot formation relief; volume and vibrowave impact; reduction of oil viscosity;
- *reduction of environmental effects from traditional hydrocarbons extraction*. Failure reports of alternative energy production companies and a drop of *WilderHill Clean Energy Index* to 55% from its starting value in 2004, point to the fact that production and consumption of hydrocarbons can turn out to be less harmful than attempts to make alternative types of fuel commercially profitable;
- *development of technologies to optimise oil consumption instead of increasing its production*.

State of the Oil Refining Industry

The total design capacity of six biggest ORP as of 2014 is about 52 mln. ton/year, but the real capacity does not exceed 15 mln. ton/year. As of today, only Kremenchuk ORP is in operation. In addition, production of petroleum products is performed by 7 gas processing plants (GPP), of which the largest one is Shebelynskyi GPP. There are also over 20 light-duty plants for oil and natural gas liquids processing into directly distilled gasoline (used as raw material for petrochemical industry or as part of commercial petrol composition), commercial diesel fuel and residual oil (mini-ORP). Here we mention only enterprises, whose activity is properly certified. The total number of mini-ORP is about 90.

Until 2008, mini-ORP procured monthly up to 100 thousand ton of raw materials, which were supplied in small and rather big batches (5, 10 thousand ton and more). Besides, such enterprises received for processing up 20-30% of the total volume of produced natural gas liquids. Taking this into account, the volume of raw materials processed in 2006-2008 at mini-ORP could be estimated at 2 mln. ton, and the volume of light oils produced by them – at 1.5 mln. ton/year. These volumes, which make up 8-10% of Ukrainian market are not accounted for by any state institutions.

Oil refining industry of Ukraine has not been refocused in order to implement new technologies, minimise raw material losses, attain European quality standards and increase the export of petroleum products. It has also been planned that investors will provide ORP with the necessary volumes of raw materials, but this also has not happened. Ukraine has remained a minor export market, and domestic plants receive oil according to the leftover principle.

Problems of Oil Refining Industry of Ukraine

Dependence on import and decreasing domestic production (in 1991-2014 production of oil with natural gas liquids dropped from 5.3 to 3.0 mln. ton, which is about 1/6 of domestic market demand). In 2014, ORP of Ukraine processed only 2.6 mln. ton of raw materials, which allowed to provide the domestic market with own petroleum products for less than 15%. National oil refining industry depends on Russian supply also due to the fact that ORP are adjusted to refining "heavy" Russian oil (which is a significant barrier on the way to diversification). In the last years Russian oil delivery was minimal. This led to a standstill of almost all ORP, excluding the Kremenchuk one, which is provided mainly with oil from Ukrainian fields.

A serious lack of investments and a catastrophic situation with petroleum products quality, the lion's share of which does not meet European standards – both because of the lack of strict fuel quality requirements from the state, and because of outdated production technologies.

The latter one being explained by the fact that in the beginning oil refining industry of Ukraine was oriented mainly at production of residual oil. Raw materials conversion ratio at first ORP in Ukraine did not exceed 50%. Processes that increase the quality of the basic components of motor fuel were introduced only at three out of six ORP, while isomerisation units required for production of high-octane gasoline with low content of aromatic hydrocarbons are available only at two ORP (Odeskyi and Lysychanskyi ORP) (table "*Comparison...*" (p.32) and table "*Equipment of ORP...*").

In 2008-2009, performance of oil refining industry has slightly improved. In particular, petroleum products production volume was increased, including products with low mass fraction of sulphur. However, these positive changes were temporary: 2012 has become the worst year for the industry (diagram "*Primary Processing of Oil...*", p.36).

Unsatisfactory technical state of the industry necessitates reconstruction and modernisation of oil refining plants. Development strategy should focus on increasing processing conversion ratio – up to 80-85% and production of optimal quality fuel that meets technically, environmentally and economically justified requirements at minimum possible cost of its production.

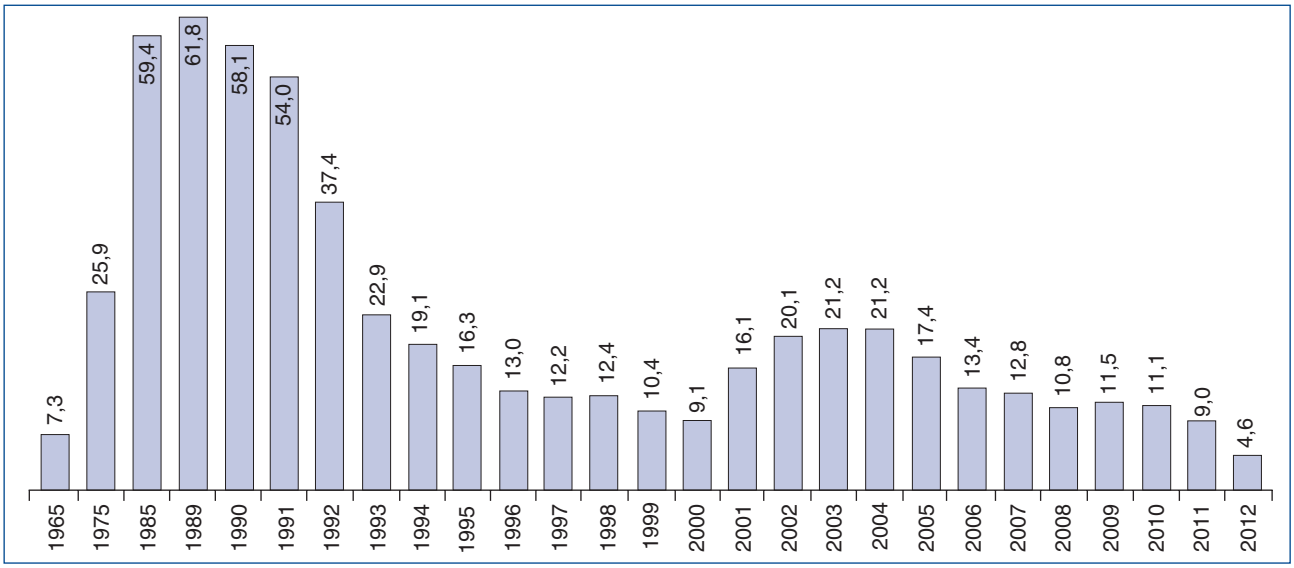
Structural changes in the consumer market. Reduction of low octane gasoline brands consumption to 5% and increased demand for A-92 and A-95 gasoline – up to 45%. Diesel fuel will retain its half of light oils market. For example, in 2009, its use was only 13% more than in 2000 (gasoline – a 67% increase), and the ratio between diesel fuel and gasoline consumption reached 1.03:1.0 (in 2000 – 1.7:1.0).

Equipment of ORP in Ukraine*

Process	Lysychanskyi	Kremenchutskyi	Khersonskyi	Odeskyi	Drohobytskyi	Nadvirnyanskyi
Primary processing	+	+	+	+	+	+
Catalytic reforming	+	+	+	+	+	+
Hydrofining of fuel	+	+		+		
Catalytic cracking	+	+				
Thermal cracking					+	+
Rerunning of gasoline				+	+	+
Isomerisation	+			+		
Delayed coking						+
Bitumen production	+	+	+	+	+	
Production of MTBE	+	+				
Lubricating oil production		+				

* Summary of Data from Enterprises.

Primary Processing of Oil in Ukraine in 1965-2012*,
mln. ton



* Summary of Data from the Ministry of Energy and Coal Industry of Ukraine.

Absence of state planning. The only programme for oil refining industry development was created in 1993 and was never implemented. Since that time no documents of strategic character have been adopted.

Adverse regulatory, tax and tariff policy. What is meant is firstly the rejection of "higher quality – lower taxes" principle, unsatisfactory situation with VAT refunds and unjustified railway transportation tariffs for black petroleum products.

Non-transparency of fuel market. As we know, one of the tasks of the state is to implement effective regulatory policy. But without accurate pricing and balance information, the government is unable to provide adequate and timely response to emergence of crisis tendencies.

Financial hardships in the industry. All ORP in Ukraine work with losses or minimal profit, without sufficient floating capital for stable work and own financial resources to implement modernisation programmes.

Lack of incentives for businesses to perform large-scale reconstruction. Completed works include replacement of outdated equipment, just enough to support capacities in the working condition. State control over execution by owners of their investment commitments in the part of ensuring production of high-quality fuel is not exercised. Incentives (tax, customs) and coercive measures (fines, cancellation of shares sale contracts) are not applied.

High-Potential Investment Areas in Oil Refining Industry

Major global trends in the oil refining industry development are:

- *growing volumes of heavy oil and bitumen processing.* The technological challenge is in the need for skilled and high conversion ratio processing of such raw materials, using a combination of traditional and fundamentally new technologies. There is a tendency to transfer certain processes of preparation and refining of heavy oil from ORP directly to the fields, thus allowing to use the full potential of existing ORP;
- *hydrocracking and hydrotreatment* in processing of heavy raw products. The examples of processing of heavy oil are H-oil, LC-Fining and slurry mode processes that are being developed by KBR and Eni;
- *increasing demand for high-quality environmental motor fuels with simultaneous reduction of petroleum products consumption in energy sector and industry branches;*
- *increased oil conversion ratio, which remains the main priority for ORP development*. Modern hydrocracking systems allow to receive more than 70% of motor fuels in outcoming vacuum distillate; in this case products contain minimal amounts of sulphur and other undesirable components, and usually do not require additional refining;
- *comprehensive approach to oil refining and increasing the output of high-tech products*. Application of "omnivorous" by raw materials technologies that allow to use in processing the by-products and waste products of other industries;
- *conversion of hydrocarbon resources into more valuable and easy to operate, such as processing of heavy oil and bitumen, replacing oil with natural gas in industrial processes, waste disposal, including polymers, into synthetic oil and petroleum products;*

- *rapid development of the petrochemical sector* and *transition from "dirty" processes to technologies consistent with the principles of "green chemistry" and energy conservation.* The introduction of the European REACH regulation will encourage companies' transition to high-performance environmental technologies.

2. State of Gas Industry

As of 1 January 2012 proved reserves of natural gas in Ukraine, according to official data, amounted to 1193 bln. cu. m (category C_2+C_3), inferred resources amounted to 3491 bln. cu. m (category D_1). The most promising is the Eastern region with 43% of total volume of inferred natural gas resources. Over 50% of these resources are located at a depth of 4000-6000 m. Good prospects for the search and development of new deposits in Ukraine are contained in the shelf of the Black Sea and Sea of Azov with 46% of the total volume of inferred natural gas resources. Inferred volume of unconventional gas is estimated at 1.2 trn. cu. m of shale gas, 8.5 trn. cu. m of tight gas and over 12 trn. cu. m of coalbed methane. Resource base, on condition of its efficient use, allows not only to provide for a long-term stable production volumes, but also to increase them in the future. Potential conventional gas resources in Ukraine are currently estimated at 6 trn. cu. m, proved reserves – 1.1 trn. cu. m.

Ukraine is one of the largest consumers of natural gas in Europe. In 2013, the volume of gas consumption in Ukraine was approximately 50.4 bln. cu. m, which is 8% less than the same indicator in 2012. Over the last decade, this figure varied depending on the political and economic situation in Ukraine, from 76.4 bln. cu. m in 2005 to 42.6 bln. cu. m in 2014.

Nearly half (27 bln. cu. m) of total gas consumption is spent on the needs of the population and district heating system supply, including state-financed organisations and utility users. Over 2 bln. cu. m is used for the needs of combined heat and power industry – coal TPP (as auxiliary fuel, incl. for intensifying coal capacity), CHP and IGS, while gas-residual oil TPP units remain in the reserve for long periods of time and are not exploited due to high gas prices.

Industrial branches in total consume a little under 40% of the total volume of natural gas consumption, the main industrial consumers of natural gas being iron and chemical industry enterprises.

Consumption of natural gas in Ukraine is provided by imports and domestic production.

Ukraine remains Europe's largest transit country of natural gas – transporting Russian gas to 18 European countries.

Input design capacity of Ukraine's GTS is 288 bln. cu. m per year, output – 178.5 bln. cu. m per year, incl. in the direction of EU countries, other European countries and Turkey – 142.1 bln. cu. m per year.

In 2013, natural gas transit for CIS and European counties was at 86.1 bln. cu. m. Accordingly, existing potential for increasing the volume of transit through Ukraine's GTS is about 50 bln. cu. m of gas per year. At the same time, the RF has reduced gas transit through the territory of Ukraine by 27.8% or for 23.9 bln. cu. m in 2014 as compared to 2013, first of all, due to political reasons.

Ukrainian gas storage complex has a considerable reserve, which in the nearest future may be used for increasing gas storage volume of foreign companies. The total volume of Ukraine's UGS allows to store 31 bln. cu. m of gas.

The required amount of gas in UGS to meet the needs of Ukrainian consumers amounts to 16 bln. cu. m. Thus, natural gas storage capacity of Ukraine's UGS available for European companies is estimated at 15 bln. cu. m. At the same time, it would be reasonable to set a minimum volume of stored state reserve natural gas for each underground gas storage facility through the legal and regulatory acts of the Government of Ukraine, as well as a technologically minimal level of gas, below which drawing from the corresponding UGS is prohibited.

3. Electric Power Industry

United Power System (UPS) of Ukraine is one of the biggest energy systems in Europe, the total installed capacity of power plants being 54.5 GW.

Currently, UPS of Ukraine operates synchronously with energy systems of the RF, Belarus, Moldova, other CIS and Baltic countries. Western part of the UPS of Ukraine, the so-called "Burshtyn TPP island", is separated from the main system and operates synchronously with ENTSO-E, which allows to export electricity to European countries.

Main power transmission lines of Ukraine stretch over 23.19 thousand km, from them 4.93 thousand km are 400-800 kV networks, 13.42 thousand km – 330 kV networks, 4.14 thousand km – 220 kV networks and 0.7 thousand km – 35-110 kV networks, and include as well 136 substations with total transformation capacity of 78,631.6 MW.

Electrical distribution networks have about 1 mln. km of 0.4-150 kV overhead and cable power transmission lines and about 200 thousand 6-150 kV transformer substations.

Traditionally, electricity production sector is dominated by TPP and NPP by installed capacity and volume of production. NPP provide about 48% of total domestic electricity production using only 25% of total installed capacity.

Power generation companies that operate TPP provide about 40% of the annual total electricity production and represent second largest producer of electricity in Ukraine. The majority of Ukrainian TPP units have been commissioned in 1960-1975.

As of 1 January 2014, 84 TPP and CHP units with total capacity of 20,230.0 MW, or 37% of the total installed capacity of domestic power plants, have worked over 200 thousand hours and have exceeded the limit of physical wearing-out, service limit and designed life resource. In total, 102 power units have served their estimated time and require modernisation or replacement.[1]

Given the lack of regulatory capacities in the UPS of Ukraine (mainly present at HEP and insignificantly at PSP, the total share of which in capacity balance is about 10%), TPP are intensively used to regulate daily load fluctuations and, accordingly, in addition to provision of baseload, play an important role in load schedules regulation.

Accelerating the pace of construction of power plants using RES, in particular, wind power plants (WPP) and solar power plants (SPP), working exclusively in the basic mode, requires significant amounts of reserve capacities, which, accordingly, should be provided by manoeuvrable generating capacities (HEP, PSP and TPP). It must be kept in mind that the existing balancing system has not been developed on market-based principles and is not grounded on clear division of responsibilities, and thus does not provide economic incentives for precise account settlement, reduction of gaps, introduction and support of energy market prices through state measures (the so-called valorisation) with the purpose of balancing out services provided by respective facilities.

In recent years, growth of electricity consumption has been recorded in Ukraine, which in 2011 reached the pre-crisis level of consumption (the 2007 level), with further minor fluctuations. Thus, in 2013, consumption of electricity declined for 2.1% as compared to 2012.

According to 2013 results, electricity losses in Ukraine's UPS networks amounted to 20.1 bln. kW*h, or 10.94% of electricity consumption volume (gross).

The level of power loss in Ukraine's UPS networks is caused by their long period of exploitation, limited financing of reconstruction, modernisation and new construction of transmission and distribution electricity grids. As of 1 January 2013, 42.2% of overhead 220-330 kV power transmission lines have been in use for over 40 years, 64.4% of main equipment at transformer substations has exceeded its estimated service life. In electrical distribution networks, a large number of facilities has also exceeded its service life: 40.5% of electric power networks and 37.4% of transformer substations require capital overhaul, reconstruction or substitution.

As a result of implementation of investment programmes, there is a gradual reduction of normative and excess losses of electricity in networks. Based on results of 2013, energy supplying companies have allocated 3,280.0 mln. UAH or 87% of the total cost of investment programmes for technical development of local electrical networks and for measures to reduce and/or prevent excess power consumption. It should be noted that the regulated prices for electricity supply are still at the comparatively low level due to social factors and, correspondingly, do not fully cover the costs for electrical networks maintenance and development, even despite the regulatory measures taken by NERC. Programmes for support of vulnerable consumer categories have not been properly developed and implemented.

Wholesale Electricity Market (WEM), which operates as a mandatory pool – DP Energorynok, is the main part of electricity market of the country and the only institutionalised electricity market in Ukraine. Through WEM, selling and purchasing of over 90% of electricity is conducted.

The current WEM model does not foresee existence of a direct bilateral agreements with customers sector, segments of a balancing market and a market of ancillary

[1] Excluding losses incurred by Slovyansk TPP.

services. Energy suppliers buy electricity at the WEM for wholesale and retail prices, which are formed by the hour on the basis of current-day proposals of coal TPP, and are the same for each hour and for all suppliers.

Main Power Transmission Networks and Interstate Networks

As of 1 January 2013, 47.5% of all power transmission lines have been in use for over 40 years, 68.5% power transformers and 66.4% of 35-750 kV switches – for over 25 years, which conditions an increase of exploitation expenses for equipment repairs and maintenance. Aging of equipment at transformer substations, elements of power transmission lines and deterioration of climatic conditions in Ukraine lead to increased accident rate and technological losses of electricity during its transportation, causes an increased number of equipment shutdowns and its damage.

With the purpose of fast physical integration with ENTSO-E and immediate start of physical electricity supply or exchange with the neighbouring EU member states (Romania, Hungary, Slovakia, Poland) until full synchronisation with ENTSO-E network, high priority should be given to construction of back-to-back facilities such as HVDC. Besides their commercial advantages and improvement of investment climate, construction of such facilities increases system stability, security of supply, wholesale market liquidity, and diversifies energy supply sources.

After synchronisation with ENTSO-E is achieved, similar energy conversion facilities can be used for similar purposes of interconnection with energy systems of Russia and Belarus. Another priority direction is implementation of electricity market coupling with Moldova. The advantages here are similarity of technologies, proximity and synchronism of systems, as well as the general policy of both countries aimed at integration in the EU with potentially coherent measures for such integration, which allows to make immediate steps in this direction (without fulfilment of conditions for preliminary synchronisation with ENTSO-E).

The mutual benefits of market development are: diversification of market players, increased liquidity and competition, testing practices of cross-border rules and mechanisms coordination, cooperation in regulation and best practices application, simpler dispute resolution. There are also mutual benefits of such cooperation in the sphere of security (considering the geopolitical factor – Transnistria), as well as the possibility for implementing joint projects and mutual investments, use of complementarity and synergy. The condition is to receive Moldova's consent to participate in such energy system integration.

Priority development areas for Ukraine's main power transmission networks and international networks, which will significantly improve the transmission of electricity, are:

- removal of network restrictions on the output of installed capacity at Khmelnytskyi, Rivne, Zaporizhzhya NPP and regulatory capacities of Dniester PSP;
- improvement of electricity supply reliability to certain regions of Ukraine, including Kiev, Odessa and the eastern Donbas, in compliance with criteria of reliable work of the power network (N-1);
- reconstruction of substations and power transmission lines;
- introduction of reactive power compensation means at facilities of the main power transmission network to ensure compliance with standardised quality indicators for electric networks in network reference points, especially, at SP busbars of 220 kV and above;
- reconstruction of communication system on the basis of fibre optic networks, protective relay systems and emergency automation features in order to bring characteristics of main power transmission networks in compliance with ENTSO-E requirements;
- connection of alternative energy units.

Creating Conditions for the Start of Integration of Ukraine's UPS with ENTSO-E

On 4 June 2014 the Ministry of Energy and Coal Industry of Ukraine has approved Order No.409 "On Ensuring Implementation of Project for Integration of Unified Power System of Ukraine into the Interconnected Power Systems of EU Countries". The Order defined the term for creating conditions for parallel work with EU power systems and integration of markets – IV quarter of 2016.

Integration of Ukraine's UPS with the European power system will allow to:

- enhance energy security of the country, which is of particular relevance considering the recent changes in relations with Russia;
- create possibilities for integration of electricity markets and capacities of Ukraine and the EU;
- create diversified energy sources and different types of energy resources based on the European continent;
- expand grounds for sharing innovative technologies, create a favourable climate for the development of business cooperation and investment attraction;

- improve the technological level of operation through more efficient use of available production capacities.

Project Implementation Stages

Stage A – Developing proposals for the Agreement to be signed by DP NEK Ukrenergo, Moldelectrica and ENTSO-E. It is necessary to perform research on technical, regulatory and operational conditions of work, and based on results, to develop requirements that must be met in order to connect Moldovan and Ukrainian power systems to ENTSO-E.

Stage B – Implementation of Agreement provisions. In order to meet ENTSO-E requirements and standards, Ukrainian and Moldovan power systems have to have implemented all technical and organisational measures defined by the Agreement.

Stage C – Preparation and testing in separate operation mode and interconnection of power systems. Evaluation of test results. It is necessary to conduct testing of separate work and testing in interconnected power system mode with a synchronous area.

UCTE Steering Committee[2] has reviewed and accepted the application for membership in UCTE synchronous area, as a single regulation unit, from power systems of Ukraine and Moldova back in 2006. The terms of reference for the development of "Measures Catalogue" were approved in 2008, and in 2011 EU has allocated funds for execution of this research. Until now, the research has not been started.

Implementation of technical and technological standards of the European Network of Transmission System Operators for Electricity ENTSO-E on the functioning of Ukraine's UPS requires substantial modernisation of power generating facilities and electricity transmission infrastructure, which can be executed only with involvement of significant amounts of investment in the sector.

There are two approaches to ensure integration of Ukraine's UPS into the interconnected power systems of EU countries:

- through full synchronisation of energy systems operation (requires large-scale modernisation and respective investment);
- through the construction of DC inserts on interstate (main) power lines and/or DC power lines that provide the necessary conversion of electrical energy in the asynchronous power systems (requires construction of the named above infrastructure facilities of electricity transmission and much less investment as compared to the first option).

To ensure reliable power supply to consumers in Ukraine and the ability to import electricity, as well as further development of Ukraine's UPS in the context of increasing electricity export. The first approach is a priority task. Later, it is advisable to perform complete network interconnection and synchronisation.

Reforming of DP NEK Ukrenergo

The goal of reform is to increase the transparency of tender procedures and reporting, improve the quality of work of employees, divide types of activity into transmission and operational dispatch management, attract highly qualified personnel, bring all company's operation procedures in compliance with best global practices, gain full operational and investment policy independence, as well as bring operation in compliance with 3rd EU Energy Package and Eurocodes requirements.

Changing organisational structure of DP NEK Ukrenergo requires new legislative basis (new version of the Law on Electricity Market), which should fully transpose 3rd EU Energy Package, and a decision on the choice of structural division model for the Company, which should also be in line with 3rd EU Energy Package. As soon as the new Law on Electricity Market is adopted, all measures for its implementation are to be realised step-by-step, which must be completed by 2017. The complex of measures is to ensure creating conditions for operational management and decision-making processes both inside the Company and in connection with it, based on procedures defined by the Law, while gradually attaining compliance with Eurocodes along with their adoption and implementation. In order to be recognised by ENTSO-E, DP NEK Ukrenergo must be certified as Transmission System Operator for Electricity both by its national regulator – NERC, and Energy Community Secretariat, according to the mandatory legal procedure.

In addition, transformation of DP NEK Ukrenergo requires the following steps:

- dividing the company into types of activity: transmission network operator and system operator;
- organisation of telecommunications operator, a company for repair and maintenance;
- separation of inspections, industry-specific scientific enterprises and organisations into individual enterprises (organisations);
- changes in the structure of enterprises through reduction of management levels, centralisation of back office, creation of vertically integrated management structures;

[2] UCTE was dissolved on 1 July 2009. From this date, the successor of UCTE is ENTSO-E.

- ensuring an adequate level of wages (through introduction of a modern resource management system, facility automation, process optimisation and reduction of staff).

Creating and approval of company's technical policy:

- reduction of facility design costs through the development and implementation of standard projects (especially in facility automation);
- performing turnkey retrofits with construction of facilities without operating personnel;
- total enterprise automation;
- providing efficient, reliable and safe operation of equipment.

Development of Distribution Networks

The only source of funding and ensuring payback from investment programmes of power supply companies are the money from electricity transmission and supply tariffs, so investment programme funding volumes are determined and limited by NERC based on the need to avoid electricity price increases for end users.

In the absence of a competitive retail market, the best pricing policy is the one that includes complete cost payback in energy prices, including the required maintenance and development cost, without attempts to keep using the so-called cross-subsidisation. Also, one of the key conditions for electricity distribution networks development is implementation of "incentive rate-making" methodology, which would provide incentives for increasing energy efficiency, attracting investments and fixed assets renewal. In the process of tariff policy formation, it is necessary to abandon the "cost-plus" pricing principle, and make a transition to the "competitive markets" principle.

In 2013, NERC adopted regulations for implementation starting from 2014 of incentive rate-making, but the proposed by NERC tariff reform parameters – zero return on the "old" assets in 2014 actually halted implementation of the reform.

Given the current condition, it is necessary to accelerate modernisation and development of electric power distribution networks. In the general World Bank rating *Doing Business-100*, in the part of small and medium businesses receiving approval to connect to networks, Ukraine in 2014 took 112th place, in the component of receiving electricity – 172nd. Comparison of Ukraine's place with CIS countries and Poland is shown in table "*Comparison of Ukraine's place...*".

Thermal Generation

The majority of Ukrainian TPP units have been commissioned in 1960-1975. TPP equipment is characterised by low reliability and efficiency index, as well as by high levels of pollutant emissions. In the past 20 years, no new TPP capacities have been commissioned.

Since 2007, a gradual reconstruction and modernisation of power units at some TPP has been carried out, which has improved their technical and economic parameters and, in most cases, led to an increase of installed capacity for 15-20 MW. Condition of power generating equipment of TPP and CHP is presented in table "*Technical condition of equipment...*" (p.42).

Given the limited investment resources, such condition of equipment at electric power facilities leads to poor technical and economic performance of power generating companies and, consequently, to high cost of electricity generation.

Because almost all TPP in Ukraine are private-owned and take active part in load schedule regulation, in the process of creating a mechanism of investments in

Comparison of Ukraine's place to CIS countries and Poland in the rating by the component of consumer receipt of electricity

Indicator	Ukraine 2013	Ukraine 2014	Belarus 2014	Kazakhstan 2014	Kyrgyz Republic 2014	Moldova 2014	Poland 2014	Russia 2014
Receiving electricity (place)	170	**172**	168	87	180	165	137	117
Procedures (number)	11	**10**	7	6	7	7	6	5
Period (days)	284	**277**	161	88	159	140	161	162
Cost (% of income per capita)	192,3	**178,0**	431,7	65,3	2 256,4	542,1	205,2	293,8

Technical condition of equipment of TPP and CHP power generating units as of 1 January 2014, as of 1 January 2014

Technical condition of equipment	Number of power units	Total capacity, MW	Number of hours in operation, thousand
Exceeding the limits of physical wearing-out, service limit and designed life resource	84	20 230	over 200
Exceeding service limit and designed life resource	9	2 516	170
Exceeding designed life resource	9	5 675	over 100

thermal power generation (TPP), it is necessary to overcome the following negative consequences and barriers:

- The presence of a private monopoly company in the sector of thermal power generation and in the coal market;
- Monopolistic situation of thermal generation in a number of segments of new market model;
- Possibility of thermal generation influence on formation of limit (marginal) market price a day in advance.

The most appropriate market mechanism for attracting investment in thermal generation can become capacity market or bilateral agreements market (for capacity or for electricity with consideration of capacity), in combination with an efficient market-oriented balancing mechanism. In any case, deregulation in electricity generation sector and cancelling of subsidies in any form in the entire electric power sector, are one of the first measures to be taken for market reforms implementation in Ukraine.

The Law of Ukraine "On Ratification of the Protocol on Ukraine's accession to the Treaty establishing the Energy Community" foresees measures for implementation of European environmental standards in electric power industry until 1 January 2018, implementation of requirements for achieving at power generation plants of European maximum allowable emissions of fly ash, sulphur oxides and nitrogen according to EU Directive 2001/80/EC on establishing the limit for emissions of certain pollutants into the air by large combustion plants, whose thermal power is 50 MW and over.

Energy Community Ministerial Council, on 24 October 2013, adopted two decisions, which contain rules for design and operation of large combustion plants. According to their first decision, the Ministerial Council allows the contracting parties to use until 31 December 2027 their national plans for emissions reduction as an alternative to the option of maximum allowable emission levels set by Directive 2001/80/EC. In practice this means that conformity of emission levels is not checked individually at specific power generating unit or installation, rather, their maximum allowable level is defined for the country in general (calculated using maximum allowable emission levels set by Directive 2001/80/EC). Thus, the contracting parties have more flexibility in making decisions on the sequence of investments to be made in respective energy sectors. In their second decision, the Ministerial Council approved that in case of construction of new installations (entirely new construction or new units, which involves their complete modernisation), the contracting parties must implement provisions of Directive 2010/75/EU that regulates industrial emissions as of 1 January 2018. Thus, when making a decision regarding the prospects of a "new unit", those combustion facilities, which have been issued permits until 1 January 2018, or operators of which have presented a complete application for receiving a permit until this date (on condition that such units are commissioned not later than 1 January 2019), are to be treated as already existing units. All the rest of the units are to be treated as new units.

In the environmental area, certain relevant EU Directives' norms have been adopted on the level of national legislation, but their implementation mechanisms have not been defined.

So far, Ukrainian State Targeted Programme has not been developed and, therefore, not approved by the Cabinet of Ministers of Ukraine, for limitation of emissions of certain pollutants into the air from large combustion plants of Ukraine's electric power sector (TPP, CHP). At the same time, Ukraine is developing a plan for reduction of emissions (similar to the national plans for reduction of emissions of EU member states), and development of this document is in its final stages.

It should also be noted that ecological modernisation in the electric power industry requires attracting large-scale investments in power generating companies (Energy Strategy of Ukraine for the Period until 2030 defines the need to attract 170 bln. UAH for modernisation of existing TPP units, including 100-110 bln. UAH for installing equipment for reduction of pollutant emissions, for which modernisation there are currently no real sources).

Given the latter, there is an urgent need for implementing on the legislative level of a mechanism, which would stream the environmental fee money paid by power generating companies to TPP and CHP in the ecological modernisation of these plants.

Hydropower Industry

Hydropower plays an important role in ensuring stability of Ukraine's UPS, since it provides the energy system with high-manoeuvre capacities for regulating daily load schedules, covering peak loads and filling night gaps, and also serving as an emergency reserve capacity.

Commissioning of just the Dniester PSP will allow to satisfy the existing demand for peak capacities of Ukraine's UPS in the future until 2015-2020. Systemic effect of launching the first phase of the Dniester PSP is about 700 mln. UAH/year due to reducing the number of start-ups of TPP units (saving gas, fuel oil), stabilisation of their load and efficiency coefficient (saving coal).

In the period until 2020, under conditions of early integration of Ukraine's UPS with ENTSO-E, in order to provide sufficient volume of reserves and reliable electricity supply to consumers of "cheap" electricity, it is necessary to implement the following investment projects towards "large" HPP and PSP:

- finish construction and launch into operation by PAT Ukrhidroenerho (PJSC "UkrHydroEnergy") of the I phase of Dniester PSP consisting of 3 hydroelectric units with a total capacity of 972 MW;
- finish construction and launch into operation by DP NAEK Energoatom of Tashlyk PSP consisting of 6 hydroelectric units with a total capacity of 900 MW;
- design and start construction of the II phase of Dniester PSP with a total capacity of 1,296 MW and consisting of 4 hydroelectric units (HU4-HU7), 324 MW each;
- complete financial and technical preparatory work to start the project of Kakhovka HEP expansion for the total capacity of 270 MW, consisting of 6 hydroelectric units, 45 MW each, and the transfer of existing 335 MW of HEP capacity from the base zone to peak and semi-peak.

Nuclear Power, NPP, Safety and Nuclear Fuel

As of 2014, there were 15 power units in operation (13 WWER-1000 and 2 WWER-440 units) with a total installed capacity of 13,835 MW, which, on the average, have worked about half of their design lifetime. In 2010-2013, operation term of Rivne NPP units No.1 and 2 was extended for the 20-year period, up to December 2030 and December 2031, respectively. In 2013, operation term of South Ukraine NPP unit No.1 was extended for 10 years – until 2 December 2023. Scheduled measures are being carried out to extend operation term of South Ukraine NPP unit No.2 and Zaporizhzhya NPP units No.1 and 2. In a more distant perspective (until 2025), the major part of NPP units will require extension of their operation term.

Finishing construction of units No.3 and No.4 at Khmelnytskyi NPP at existing sites of Khmelnytskyi NPP would provide additional capacity of 2000 MW. This construction must be carried out taking into account the possibility of introducing new technologies and partnerships with leading international companies.

According to Resolution of the CMU as of 7 December 2011 No.1270 "On Approval of Comprehensive (Summary) Programme for Increasing Safety Level at NPP Units", DP NAEK Energoatom is implementing respective measures. The total cost of the measures is 20.101 bln. UAH (incl. VAT), specifically, in 2014 – 4.072 bln. UAH.

Diversification of nuclear fuel sources is required in order to reduce the risks of total dependency on Russian monopolistic supplier. According to the Agreement between the Government of Ukraine and the Government of the United States of America, we continue implementation of the Nuclear Fuel Qualification Project for Ukraine as of 5 June 2000 and the contract between DP NAEK Energoatom and Westinghouse company. The contract foresees production and supply during 2011-2015 of nuclear fuel for the annual recharge of 3 WWER-1000 NPP units (i.e. 15 fuel lots).

It remains important to create a centralised repository for spent nuclear fuel (CRSNF), which would allow to avoid the dependency on monopolistic services of Russian enterprises for processing and interim storage of spent nuclear fuel of Ukrainian NPP, and save annually up to $100 mln.

Decision on CRSNF construction has been approved by the Law of Ukraine "On Management of Spent Nuclear Fuel Regarding Location, Design and Construction of a Centralised Repository for Spent Nuclear Fuel of WWER Reactors at Domestic Nuclear Power Plants" dated 9 February 2012. By its Order No.399-r of 23 April 2014, CMU has given approval to DP NAEK Energoatom to build a centralised repository for spent nuclear fuel from WWER reactors in the Chernobyl NPP exclusion zone. DP NAEK Energoatom has assumed functions of the CRSNF operating organisation.

To prepare for the future decommissioning of NPP units, it is necessary to restore the mechanism for accumulation of financial reserve funds foreseen by the Law of Ukraine "Law of Ukraine "On Regulation of Issues Related to Ensuring Nuclear Safety".

Uranium Raw Materials, Nuclear Fuel

By explored reserves of uranium, Ukraine ranks first in Europe and sixth in the world. Ukraine owns 1.8% of the world's explored uranium reserves, has 12 well-explored uranium deposits and unique (largest in Europe) deposits of zirconium. In Ukraine, there are companies that process uranium and zirconium ore, an exploratory industrial base and technologies for production of nuclear-grade zirconium and hafnium and rolled zirconium; it is the third country in the world, after the United States and France, that produces pure hafnium. In spite of this, domestic production of uranium raw materials meets Ukraine's NPP demands only for 30%.

Further growth of production volume is expected due to development of new deposits. In particular, the development of Novokostyantynivske uranium ore deposit (design capacity – 1500 thousand ton/year) will allow for a gradual increase of production to meet the level of Ukraine's natural uranium demand and for establishing a basis for further development of the uranium-mining industry in Ukraine. Based on its uranium deposits, Novokostyantynivske occurrence is one of the biggest in Europe.

Starting from 2011, exploratory ore mining has been taking place at Novokostyantynivka mine. Funding sources for the measures aimed at increasing production volume of natural uranium concentrate are state budget and own funds of State Enterprise "Eastern Mining and Processing Plant". In 2013, the volume of capital investment of own funds amounted to 83.5 mln. UAH.

The concerns of funding for the programme of increasing production capacity and production of uranium concentrate, as well as diversification of sources of chemicals reagents supply for uranium production are key issues of the company development.

Given the significant share of nuclear power in the electric power balance of Ukraine, significant natural raw material resources, available industrial and scientific-technical potential, in order to reduce dependence on imported energy sources, the programme of domestic production of nuclear fuel for NPP is being implemented.

In 2013, construction was started in Ukraine of a plant for producing nuclear fuel for WWER-1000 reactor units. Order of the Ministry of Energy and Coal Industry of Ukraine dated 27 May 2013 No.279 imposed on PJSC "Nuclear Fuel Production Plant" the functions of operating entity (operator) of the nuclear installation for the future enterprise on production of nuclear fuel for WWER-1000 reactors, in order to perform design, construction, and commissioning work, as well as operation and decommissioning of the Nuclear Fuel Production Plant.

4. State of Coal Industry

Inferred coal reserves in Ukraine are 117.5 bln. ton, including explored reserves – 56 bln. ton. For the past 15 years, production remained virtually unchanged in the range of 72-83 mln. ton of ROM coal per year.

Coal industry before terrorist and military operations in Donetsk and Luhansk oblasts in 2014 fully met the existing demand for coal products of TPP and heating stations, population and other consumer needs. Only in coke-chemical production there is a need to import certain brands according to qualitative indicators.

Extraction conditions are complicated by deep location of deposits, their small thickness, high level of explosion hazard (high methane content – about 90% of mines) and other unfavourable geological conditions. On the average, *methane outbursts amount to 20 - 30 cu. m.* per ton of extracted coal. Among the explored reserves, 80% is made up of deposits *less than 1.2 m thick.* The depth of deposits that are currently developed is, on the average, 700 m. *Every sixth mine is over 1000 m deep. These conditions make Ukrainian mining one of the most difficult and dangerous in the world.* In the world, coal mining is almost never performed under such conditions.

The structure of mine assets of state coal mining companies indicates the ageing of main assets (40% of all mines have been in operation for over 70 years); we should also point out a significant delay in the pace of reconstruction and technical re-equipment of mines, the presence of obsolete technologies and decreasing scientific potential in the industry.

EXPERT DISCUSSION "NEW ENERGY STRATEGY OF UKRAINE UNTIL 2020: SECURITY, ENERGY EFFICIENCY, COMPETITION"*

It has become a tradition for the Razumkov Centre to hold expert discussions on key issues of energy policy and security. On 27 February 2015 an expert discussion was held for evaluation of a draft of the New Energy Strategy 2020 (NES 2020). The event was attended by leading Ukrainian experts and scientists in the energy sector, recognised representatives of civil society, people's deputies, businessmen and diplomats.

The following issues were proposed for discussion:

1. Energy sector of Ukraine: tendencies, problems, prospects.

2. Foreign and domestic threats to Ukrainian energy security.

3. Priority areas of Ukraine's energy sector reform and the legal framework for such reform.

During the discussion a wide range of ideas were expressed regarding the provisions of draft NES 2020. All of them were professional, constructive and aimed at creating high quality legal, management, economic, and institutional mechanisms of facilitating the functioning of the Ukrainian energy sector – in the best interest of the entire society and country, as well as national economy.

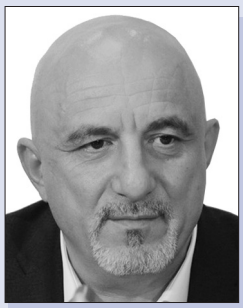
Also, a number of topical issues that concern the development of Ukraine's energy sector were brought up: the causes of downturns in the energy sector, problems in government administration and regulation, formation of energy balance, formation of tariffs for energy resources, energy consumption projections, improving energy efficiency of energy resources consumption, prospects for using RES and others.

Most speakers, in addition to outlining the problems, also provided their proposals regarding legal and economic measures for energy sector reforms. On the whole, expert discussion participants gave a positive assessment of draft NES 2020, but also expressed certain criticism regarding a number of its provisions. Those proposals and criticism proved to be valuable help for the Razumkov Centre's experts in the process of the follow-up revision of the document. Most of them are consistent with the concept of the document and are included in its final version.

This concerns the following issues: increasing the share of RES in the TPES; improving the state management system in the energy sector; clarification of priorities and tasks of the NES 2020, improving the legal framework; incentives to attract investment in the reconstruction and modernisation of energy infrastructure; creating competitive energy markets with consideration of the need to reach a balance between the interests of energy resources producers and consumers; integration of Ukraine's energy infrastructure into the common legal and technological space of the EU. During the revision of the document, we also took into account proposals for solving decarbonisation problems, as well as for ensuring a real independence of the national regulator from any political influence through creating the necessary conditions for its financial independence and autonomous decision-making.

* Presentations represent summaries of transcriptions and are published in the order of their appearance.

THE STRATEGY SHOULD BE SUPPLEMENTED WITH AN ENERGY BALANCE



Ivan PLACHKOV,
Chairman of the All-Ukrainian Energy Assembly (NGO)

I would like to express a few ideas, without a deep analysis, regarding the situation as a whole and in the light of the "New Strategy" that has been developed.

First. At the time of gaining its independence, Ukraine possessed one of the most powerful and technologically advanced energy complexes, since it was the basis for three branches of the USSR's energy expansion in Europe. Two of them have been realised – oil and gas expansion (hence the developed gas and oil pipeline networks). The third one – electricity expansion – was under way.

By the end of 1990s it became clear that we had poorly managed these energy systems. I mean the nuclear energy sector (gas transmission system has been somehow working), coal industry, energy generating electricity sector.

Approximately in 2005-2006, the need arose to evaluate the condition of the energy complex and devise a plan for its development. A rather clear energy sector development strategy was developed for the period until 2030. I headed the working group, and the main problem we faced was the unpredictability of the GDP volume with which the strategy had to be aligned. We drafted three versions – basic, optimistic and pessimistic. There were a number of unknown variables, which had to be determined by approximation. Many of the factored in estimates were incorrect. Thus, we were wrong about the forecasts for coal production and reserves. We thought there was a shortage, and it turned out to be in surplus. And so on for a number of points. Clearly, the Strategy has to be a living document that is constantly developing, changing, being worked on…

Concerning the "New Energy Strategy". At first glance, it would be reasonable to ask: what kind of strategy is it that encompasses five years? This is not a strategy, but, rather, a five-year plan. However, taking into account the dynamics of current changes, it is justified to devise a five-year strategy, especially, since it aligns with the country's development plans proposed by the President.

What else is to be planned and accomplished in order to reach ultimate precision in the energy sector development?

First, the country's energy balance is to be developed, in order to determine the volume of primary resources: coal, oil, gas, uranium ore.

Second, we are to determine the volume of secondary energy resources that we can produce: electricity, gas, heat, hydropower.

Third, analyse this in terms of consumption, the economy of each enterprise and locality. And firstly, figure out what we currently have, what the imbalance is. Secondly, determine, how and with what we can compensate for it. First and foremost, we are to make calculations, – how much of gas production have we lost due to the annexation of Crimea, what is the situation with our coal mines, – what is our balance?

The strategy will be difficult to implement for two reasons. The first one – tariff policy. The algorithm of tariff policy formation in Ukraine is a one of a kind wonder in the world. Currently, our tariffs have a great imbalance in them. We have divided the tariffs for the population: five categories for electricity tariffs, and six – for gas. There is no such thing in the world. Current populist decisions keep increasing the imbalance even more. This tariff policy is illogical. Let's remember, in 1999 Leonid Kuchma said: if we win the presidential election, we shall introduce economically justified tariffs and targeted subsidies. It is already 2015, and yet we are still talking about this. **The only formula is an economically justified price with**

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targeted subsidies for disadvantaged population. No matter how hard it may be.

The next illogical situation in the energy sector – the type of ownership. Nowhere in the world does one person hold almost 100% of shares of a natural monopoly, the operation of which affects the life of every citizen in the country. Heat, electricity, water, and gas supply companies are either state-owned (as in Finland), state and public (as in many Western European countries), or privately owned – but they are not monopolies. In the USA, energy companies are owned by hundreds of thousands of shareholders. De jure, it is private, de facto – controlled by the National Regulatory Committee bodies, the Securities Commission, the Antimonopoly Committee, etc.

The next point is **inventory tracking, assessment of primary energy resources deposits**. I think this is the biggest mystery in our country. What prospective deposits do we have to increase production of gas, oil, etc.? Trust me, even being the Minister of Fuel and Energy for a year and a half, I have not been able to get people to show me, what we actually do have at this point. Maybe I have not been persistent enough… But without such inventory tracking, we won't have anything.

A very important point – integration of Ukraine's electric power industry into the European. In 2005, a political decision had been made. The plan was to integrate in 2008. We had already almost developed a catalogue of requirements. And it is not as terrifying, as it is being said now, – to part ways with Russia and integrate. We had been working on this back at that time, every day, regularly. But then, this work was stopped. Now, with precise and reasonable work management, we can integrate by the end, or even by the middle of 2016. Energy systems of Bulgaria and Romania, when they integrated into the European structure, were not technically better prepared than our energy system. This task must be set as a priority, and this will allow us to use the electricity export potential.

The next point is to mobilise the society. This heating season showed that energy workers did everything in their power. But the society and the state were not mobilised. There was not a single mayor, rayon or oblast council head, who worked on this. Do you remember us sitting down and counting every megawatt, each gigacalorie, – and we knew, how much each village would get? Today the government machine is not participating in this essential work.

I have not detected any contradictions in the "Strategy". There were only two things: *firstly*, I did not see a roadmap, a five-year calendar plan for the implementation of measures; *secondly*, there was no specification of funding sources and cost parameters. The text needs to be enhanced with a schedule chart and cost parameters. ■

THE STRATEGIC GOAL IS TO CREATE COMPETITIVE ENERGY MARKETS

Svitlana HOLIKOVA,
Director of
TransEnergoConsulting

While working on the draft that is the subject of today's discussion, we have essentially stepped away from the traditional view of the strategy as a document. In this draft you will not see a plan for the development of each subsector, the number of power generating units that must be built or the volume of coal to be produced.

We have applied the target-based programme approach and have created this Strategy in such a way that the real strategic issues have the utmost priority. One of these issues is creating a market environment. We need to build six complementary markets:

- natural gas,
- electricity,
- thermal power (which, by the way, was not mentioned in the previous strategies),

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- oil and petroleum products (which is said to exist, but does not have strategic development), coal (possibly, the most painful one – it has to be not developed, but created practically from scratch),
- biofuel (one of the most promising markets),
- other types of alternative fuel for producing power from other sources – thermal, as well as electrical.

What are the main components of reforming these markets?

First, security issues. No market will develop under conditions of external aggression. When it started, it turned out that **Ukraine did not have a clear concept for protection of its energy facilities**. There is no legal framework for the protection of energy facilities against aggression, except the nuclear facilities. In the future, this has to become one of the key issues.

Second, the institutional component. It has already been mentioned that **we need an independent regulatory body**. And even though this is being discussed since 1995-1996, we still do not have a law on the regulatory body. Its operation is regulated by Presidential decrees, although the European community, the public, experts, and even the Government are pointing out that the regulator has to work on the basis of law, not any other regulatory document.

Third, **tariff setting system**. We should not just review our approach to tariffs, – first, we need to develop methods of their formation. I would like to point out that Paragraph 4, Article 269 of the EU-Ukraine Association Agreement allows for the possibility of gas and electricity prices regulation, but prior to them being regulated (even with a certain share of subsides), the methodology has to be published.

Fourth, **social protection**. We have to take care of this, as not all vulnerable categories of consumers and population will be able to bear the new tariffs.

It is proposed to form all markets in three stages: short-term – 2015-2016, mid-term – until 2018, and long-term – until 2020 and on. The first stage – legal framework, beginning of institutional changes; second – development of institutional changes, reforming large companies, establishing new players in the market, beginning of construction of new energy sector facilities; during the third stage – reaching the defined goals.

Gas market reform. Here's a brief summary of goals that we would like to reach. First of all, we put consumers' interests first. The market's goal is specific reduction of gas consumption indicators, i.e. gas saving. Then, – increased gas production, both, from conventional sources, and unconventional (in the future). Integration of the national GTS with the European one. Transformation of the GTS currently oriented in one direction (east-west) to a polyoriented one. We must have a flexible secure supply system. **The issue that has practically not been considered before, – the degree of operating transparency of gas production, transportation, and distribution companies.**

Which measures are required in order to establish the gas market? Complete implementation of the 2nd and 3rd EU Energy Packages, price reform, implementation of stimulating tax legislation, reorganisation of NAK Naftogaz Ukrainy and its subsidiaries, optimisation and modernisation of the GTS, extractive and transport industries transparency.

Concerning the *reform of the electricity market*. Main components – legal framework, introduction of bilateral agreements market and balancing market. Note: the law on reforming the electricity market of Ukraine has been adopted and has been in force for two years. But we do not observe any real changes. We have the legal framework, but we do not have any progress towards implementation of the market. At the same time, the current Law can be used as well as the basis for implementing certain necessary institutional changes. These are: demonopolisation of oblenergo operation (i.e., division of oblenergo's electricity transmission and supply functions), formation of a broad circle of independent traders and suppliers, creating a market system operator, as well as a network operator on the basis of Ukrenergo, which is to be divided into two companies.

We have talked a lot about integration with ENTSO, about market pricing mechanisms, protection of consumer rights. What is our Strategy missing? – Maybe some things are missing, because we were writing it at the end of last year, and we could not have taken into account all the events that took place in Ukraine. Thus, at this point, **we are lacking the outline of the current configuration of our energy system, electricity and gas transmission systems**. We have lost a number of very important assets. This is why the development plan for the new unified power system of Ukraine, its gas transmission network, has to be adjusted with consideration of the current events. Possibly, we had better admit that we have lost important assets temporarily, and start building our energy system on the basis of the new reality. Let us say, if three powerful energy companies are situated in the temporarily occupied territory, in the ATO zone, – should we develop these companies, these networks? Or maybe we should choose to build new power plants in the territory that will be protected? This is a debatable issue, which the Strategy does not analyse. But we need to think about it, and just answer openly: what will be the new configuration of the unified energy system, are we separating from Russia and going to the European system, what are we trying to reach?

Regarding electricity market benchmarks. **Nuclear energy sector remains at its core.** Thermal energy sector requires significant modernisation, even replacing certain units. These are high-capacity producers that possess maneuver possibilities. We have to implement new technologies of network construction. "Green" energy is to be developed taking into account local resources and energy consumption needs.

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Heat and power and coal market. We have never said that there is a need for such a market, but the latest events have demonstrated our vulnerability (primarily, that of the population) to the lack of heat and coal. Securing the supply of heat, electricity and coal are also the goals for the development of this market. We insist that **it is necessary to carry out an audit of all available coal mining assets, close down the unprofitable and destroyed mines, implement new coal mining technologies**. We need to develop a support programme for co- and trigeneration that uses local fuel.

These, very briefly, are market development tasks. More information can be found in the Strategy. In conclusion, I would like to say that we have no other path than the market one. At this moment, there is a great temptation of centralised administrative management. Latest events, these past months have shown that this exact temptation has affected our high-ranked officials, who explain everything by the war situation and that "we need a single headquarters". No, we have to offer another option, a different approach, – when protection from an external threat is ensured through political, military and other measures, and in the energy sector – market environment is developing. ■

UKRAINE'S PRIORITY IS ENERGY EFFICIENCY

Andriy PEREVERTAYEV,
World Bank Expert at the Ministry of Energy and Coal Industry

I would like to say a couple of words about the project, in the development of which I also took part. Unlike many documents that define strategic development of the country, this document sets clear and comprehensible key indicators.

The first thing we wanted to do while working on the document, was to determine the numbers, the guiding indicators that would show, whether we were able to achieve some results or not.

I would like to note **two aspects, which are most essential and, probably, most debatable in**

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this discussion – energy efficiency and renewable energy sources. Today, Europe has clearly determined for itself that energy efficiency measures are much cheaper than construction of new generating facilities, and the majority of the most successful European programmes are targeted precisely at keeping energy resources consumption at a constant level throughout the year. Analysis of the European balance shows that Europe has succeeded in this. This is the road we also want to take.

Energy efficiency measures are expected to have the following effect: power consumption does not grow by 2020, but rather remains at a constant level. Energy efficiency is the priority, which can ensure competitiveness of economy as a whole in the short- and long-term period.

Energy efficiency is also Ukraine's international responsibility in the framework of the Energy Community. It is important to understand (and it is essential that the expert community supports this idea) that we need to perform two huge tasks. The first one is implementation of the European legislation, in line with Ukraine's international commitments. The second – solving our domestic problems accumulated over the period of 20 years.

Today, draft legislation on energy efficiency is in the foreground, it is being discussed in the Parliamentary Committee on Fuel and Energy. I think this will remain top-priority within energy sector development.

Energy intensity of Ukraine's GDP is one of the most complex indicators with highest rates, which reflects a deep systemic crisis of economy. It is higher than the same indicator not only for the world's leading economies, but also for the neighbouring countries of Central and Eastern Europe.

Here, we define three main reasons. The distorted GDP structure, low energy efficiency in energy transformation sector, high specific energy consumption by households and the institutional sector – heating and hot water supply. The underlying problem for these is the current general and economic policy in the energy sector. Today, unfortunately, the issues of technical, technological, and administrative competition, as well as sector management issues **go in the background compared to other factors – for example, corruption**. This factor does not leave any hope for the introduction of such complex measures as energy efficiency, and makes it impossible for the energy sector of Ukraine to reach the synergy effect from the application of these measures.

The second root cause of problems is the absence of an effective regulatory policy for the monopolies. The third one – absence of a balanced tariff policy for energy resources for population. The concept of cost-based tariffs – how much a consumer pays for energy resources, how this is ensured, and what the fair price is – is different every year. This leads to a lack of stimuli. If tomorrow, for example, gas becomes cheap, the tariffs can be brought down. If a change in the tariff menu is required – we can change tariffs in the middle of the year for generating companies. Meanwhile, energy efficient projects are not one-year projects, – depending on their complexity, they cover a period from three to five years. In order to implement them, the incentives and return on investment mechanisms must be clearly outlined.

I would like to highlight **two key areas from the point of view of energy efficiency, as well as how we see the work of the government in developing these areas**. The first area is industry, three sectors of industry: thermal power industry, iron and steel manufacturing, chemical industry. According to our estimates, just here, realisation of energy-saving potential will cost about 800 billion UAH. We tried to limit planning to some extent with a five-year plan, based on the understanding that five years is the average payback period for the projects.

This is why, speaking about industry, it will be impossible to realise this potential in five years. But it can be realised by parts, in different sectors. Regarding households (whatever the opinions may be), all prices for energy resources should reach the market level. This should not become a shock therapy, rather it should take place according to a schedule, which would allow every citizen to plan his expenses.

The second area – 100% accounting for all energy resources with relevant appliances – this will help achieve the best possible energy mix.

Renewable energy sources. This is one of the main areas, where we haven't reached a decision in the Strategy (we plan to hold a separate working group discussion). If the planning horizon is five years, and we want to develop "green" sources of energy, the main question is: what can the "green" energies do for the country's energy sector within five years? There are several answers to this question, but this is a topic for a separate discussion. Energy strategy is not a dogma, it's a working document. I think, this conversation will result in specific decisions regarding the following: if we are using a short period of time, how and what areas are to be developed? We see that "green" energies should be developed by the government and with its support, speaking about gas, local energies, – as is the case in most European countries.

However, speaking about construction of a major solar or wind system, given the current situation in the energy sector, its heavy burden on the consumer, – we do not see possibilities of using "green" electricity as a real source of replacement for traditional generation until 2020. ■

STRATEGIC PRIORITIES SHOULD INCLUDE NEW TECHNOLOGIES

Ihor KARP,
Honorary Director of the Institute of Gas, Member of the NAS of Ukraine

In February, it has been 14 years since the Presidential Decree of L. Kuchma about the Development of the Energy Strategy. That was the first version. I was head of section on the development of oil and gas complex, there were 50 professionals working on it, with very good funding from NAK Naftogaz Ukrainy, and no funding from the Ministry. The process took several years, and finally the monograph was published. You can read it and see what was there and what hadn't been done. But it was all developed in detail, – starting from each well, and up to what is currently being the focus of

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attention, – regulatory measures. A consortium, changes in legislation, NAK reform – all of those were there… Then, there was a second version of the Strategy, then third, fourth... Today we are discussing the fifth one.

I think that strategies are developed for a longer term. The team has done a great job, but I would call this document an "Action Plan" or "The List of Challenges in the Energy Sector and How to Overcome Them".

I would like to see more specifics. For example, four goals are mentioned, but the first one – "Creating an Energy-Efficient Society", is something very general… "Global Tendencies" – correctly states that the global struggle for resources is escalating, but (this is an editorial note), in my opinion, the reference to civilisational differences is inappropriate. "Energy Security Formula": a combination of reduced energy consumption with balanced imports is a fundamental truth, a balance.

I am convinced that energy security depends foremost on internal factors, on the general condition of the country's economy, its political stability. This is the foundation of energy security. Ensuring a safe society will ensure energy security.

Then, energy sector priorities are listed. I counted, at first, eight, then 19, then 15 of them… They are formulated correctly, but there cannot be a lot of priorities, moreover, their wording is rather obscure. Here, I would use the IEA approach, their way to develop strategies. Their Digest notes that countries-consumers of a large volume of energy resources have in the past years revised their energy strategies, laying energy efficiency as their foundation. What is emphasised is each of their specific problems and goals: for Japan – electric power industry after the Fukushima disaster, for USA – oil import and reduced consumption of oil, for China and Europe – total specific consumption for the production of GDP until 2020. In the draft in question it is noted that we consume 2-2.5 times more energy resources per GDP unit. But this number does not take into account

the shadow sector. I am a scientist, not a politician, you should know better, which part of our GDP is produced in the shadow sector – 35 or 50%? Let us divide this scary number by two, and we shall have a more or less accurate number.

We have more non-biased factors – production structure. As a steel worker by training, I know for sure that our concentrate has less ore than that from Japan or USA, that our coke contains more sulfur, which is why we really use 25-30% more energy to produce a ton of steel compared to Japan or USA. In the chemical sector, in the production of export products, we have almost reached European rates of natural gas consumption per ton of ammonia.

The IEA document stresses the issue of natural gas and its consumption in the residential sector. We should make the same stress. They define precisely and clearly one priority – insulation of buildings, thermal modernisation, – which we should all be concerned with, as our DHC and population consume 27 bln. cu. m of gas annually.

Oil sector – this is a pure tragedy. Even though oil makes up for 10% in the total resources consumption, each of us feels the increasing prices for transportation. How could this have happened, – from the point of view of energy security? Out of six plants, two have been cut up for scrap – Kherson and Drohobych. Out of the remaining four, one is in operation, – and the domestic production provides for only 15% of our demand, the rest is imported. While in the entire world oil and petroleum product prices are going down, in our country they are increasing. And what if tomorrow Belarus or Romania, having succumbed to Russia's pressure, tell us "we won't give you any more"? I think there is one and only priority – building an oil refinery with high-degree processing – 95%. This is the path taken by many countries of the world, not only in the East, but also in the West.

Coal industry – this is a complex of mining and social issues. This draft Strategy has everything right on this issue. I would just like to remind you that in 2013 the cost of coal production in the mines was 1,350 UAH, or at the exchange rate of that time – $168. There are no such costs anywhere. Of course, it is easier to import, than to allocate billions in subsidies for mining. Once it was said correctly: for us, it is cheaper to pay each mine worker 6,000 UAH for him to sit at home. But here, I should also mention the technologies. No one in the world extracts coal in such conditions as ours. In similar conditions, coal mines in the Ruhr region of France were closed down. But we cannot do this, because we cannot solve our social issues. Personally, I see the future of coal mining in salty coal. This is Western Donbas: 300 m deep, benches 2.5 m and more – coal that can be extracted. Yes, salty coal also contains sodium, chlorine, there are problems. But this is science, we know what to do and how to do it. We ask for money. And I would like you to support the Academy of Sciences in this, so that we can present this in the form of recommendations. Technologies have been mentioned here numerous times.

Electric power industry – this is a special issue. The authors focused on market relations and regulatory issues. This is good. But such issues as the structure of production remained aside. They say, we do not have to define it now, but I think that we do, since this is the issue of investment. Production of fuel rods – there has been a lot of talk, but no action. Meanwhile, in our Academy we have made progress regarding the so-called coated particle fuel, and Ukraine is ready for its introduction.

Regarding construction of power transmission lines. Nuclear plants are working, but there are no wires! We have been talking about it for years, these are not huge expenses! Write about this.

Maneuver possibilities. We talk a lot about this, but there is a simple solution – gas-turbine super-structures, a practice used in the entire world. These are not huge expenses. Besides, we have great Ukrainian production designs for gas turbines, for example, in Zaporizhzhya.

This is why I do not want you to forget about technologies. In my speeches at forums, I always take out a flash-drive from my pocket and ask: who invented this? You sit at the computer for half a day – who invented it? Deputies? Ministers? No, – scientists invented and engineers made them. **We ask you: turn your attention to technologies, include the issue of technologies in the list of priorities**.

The main conditions of energy security are: healthy economic situation, political stability and *scientific and technological progress*. Regarding the progress. What does the Ministry finance? Anything, except technological developments. And what is the situation, for instance, in the USA? There is the National Energy Technology Laboratory (NETL), there is the Oak Ridge National Laboratory (ORNL)[1], there are institutions that develop technologies to the level, where private capital is willing to fund them. We have nothing of the kind. I have recently read a material on South Korea. After the war, similar to us, the country was in ruins, in the same state that we are now. They started from technologies, they were buying technologies in advance. So work proactively. ■

[1] *National Energy Technology Laboratory* (*NETL*) and *Oak Ridge National Laboratory* (*ORNL*) financed by the US Department of Energy. – *Ed*.

THE STRATEGY HAS TO BE A RECORD OF THE ENERGY POLICY OF THE STATE

Oleksandr SUKHODOLYA,
Head of the Department for Energy, Transport and Communications, Environmental and Industrial Security of the National Institute for Strategic Studies

National Institute for Strategic Studies. It so happened that under the order of the the Ministry of Energy and Coal Industry we were developing an alternative draft of the Energy Strategy of Ukraine until 2035. At this point, its public discussion has already taken place, suggestions and comments are being summarised, the Ministry has to make a decision regarding its adoption.

Comparing the two draft strategies, we can say that they are complementary to each other. The ideology of both drafts is identical (the reform of the energy sector); the general goals are similar (ensuring energy security of the country, as opposed to by-sector industry development goals). Methodological approaches correlate. Both drafts leave out the forecasts for energy sector development from the text of the strategy, and focus on documenting the goals. The draft is created as a mechanism to achieve them.

At the same time, there are certain differences. *Firstly*, concerning goals, for example, in the renewable energy sector, – we have given more attention to bioenergy. *Secondly*, a different time horizon: the draft in discussion covers the period of five years, while we prefer a longer period – 20 years.

There is also another thing. **Both drafts do not fit into the previous practice of creating energy strategies.** This applies, in particular, to the methodological approach and the principles of management and regulation in the energy sector. What was the earlier approach? First of all, energy strategy was created as a document for the industry sector, i.e. contained priorities for the sector and wishes of the relevant ministry. In our opinion this is a solely sector-targeted approach that does not work in the current situation. Another approach – previously, large state and private corporations played a major role in shaping strategies, – in fact, they wanted to rigidly consolidate and secure their interests, in order to use the strategy later for drawing money. Another element that differs these drafts from the earlier ones: they do not mention specific projects for construction of various facilities – about for the same reasons.

So we have two ways. Does the Strategy record facilities to be constructed or reconstructed, and sources for this, – thus actually formalising the owner that is to receive public resources? Or does the Strategy record and define the rules of the game, which allow owners to pursue their interests within these rules? This is not a theoretical question. In fact, our entire previous history led us to raising it.

The market approach virtually excludes this possibility.

Earlier Strategies were changed after being adopted. Implementation priorities were also changed, and not always in the best interests of the society. This happened, for example, with solar energy, which was given priority outside of the operating Strategy of that time. As a result, in 2013, the document was changed so that it contained other priorities, – among others, renewable energy, while, for instance, nuclear energy was somewhat neglected.

We understand why this situation occurred, but we do not speak about it honestly and do not admit it for ourselves. There is a theory according to which society is based on the dominance of influence groups in the process of making management decisions. In our country, every influence group (oligarchs or sector lobbyists), having gained access to state management mechanisms, is trying to include their interests in the documents. This exists, and we cannot hush it up.

The question is: can we change it? How do we live from now on? How do we create strategic documents, when we know that each influence group, having gained power, will include its interests in these documents?

We offered to shift the focus of goal-setting, and define the goals of strategic documents at a level higher than the interests of any groups, i.e. at the state level. We have defined the **priority – energy security of Ukraine**. What are these goals? First of all, the rate of energy efficiency. Who can deny this? No one. Development of renewable energy, taking into account problems that our country currently has.

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Thus, we have defined the goals and have presented the details in the draft Strategy by indicators. In our opinion, this provides a possibility to join efforts of all stakeholders for reaching national goals. Each influence group can find its place in realising this potential. They will not be in conflict with national interests and those of different economic entities.

Today we are at a crossroads. We can continue to focus on some facility-targeted priorities, using approaches that date back to 1991, which, in my opinion, leads to the destruction of not only the energy sector, but the entire country. **Another option – the country reforms administration and management system**. Determines the methodology of setting goals and achieving them. This is the approach we used in our Strategy. And I am happy that the Strategy in question today uses the same approach.

Two important points. Is it possible at this stage to require that the Strategy include an accurate prognosis for the development of energy sectors on the basis of socio-economic development? We would like to do so, but currently everything is so unstable that this task seems rather impossible.

Question: do we need the Strategy or not? Or can we try to come up with a correct socio-economic prognosis and a balance, which will be improved monthly, without a Strategy? Or do we still need to adopt a Strategy, possibly, not focusing much on technical matters? I think that we need to do this.

There is a proposal – let us combine two drafts into one. Because our Strategy has long-term character, it can document long-term goals, and as draft under consideration is short-term – it can be transformed into a detailed roadmap. In our Strategy, we have specifically singled out different implementation stages with different mechanisms. The Strategy that is being discussed today is a clear cut fit for the first stage. They can be merged and adopted at the top level as documentation of the long-term energy policy. In fact, **our country does not have such a document that formalises the policy**, – each department has been trying to adopt its own. So let it be the Strategy – the documentation of energy policy. ■

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THE DEVELOPMENT OF PROGRAMME DOCUMENTS MUST BE BASED ON A REAL MATHEMATICAL MODEL

Volodymyr MAMALYHA,
Executive Director,
NGO "The Supreme Council of Energy Auditors and Energy Managers of Ukraine"

Positive moments. Compared to all previous programmes and strategies, the style of presentation has improved, the large volume is good. Increasing the share of NPP is a positive scenario, we need to base the strategy on what we actually have. The tariffs have to be cost-based and the same for everyone – this is also a very important moment, we hope, that some day we will be able to reach this. Regarding the tariffs for RES: it is very important that the idea was proclaimed that regulated share of profits will eliminate any disputes between traditional and non-traditional energy branches. De-offshorisation of owners, ownership schemes – I do not really believe that this will be successful, but I would definitely like it to happen.

Weaknesses. Traditionally, all our strategies, comprehensive state programmes have always been written on the basis of one scenario, instead of multiple-choice alternatives. For some reason, the Strategy plans for a 15% economy growth within the five years of its lifetime. We should note that currently our country is experiencing an economic downturn, the war with Russia is still going on, the budget has not been revised, there is no agreement with the IMF, etc. And yet, there is hope that the energy intensity of GDP will be reduced by 20%. We still have no energy balance – this is the issue that should be the starting point of the work.

When we were developing the Strategy or certain programmes, we did not perform an audit of the industry or Ukraine's economy. Without it, there is nothing to talk about, hence the absence of an energy balance. Besides, we still need to analyse energy intensity of production. This would be the answer, which we would get from the Strategy with different versions of economic development, not to mention the sectors. Based on one version of growth, we would get one version of specific consumption, based on another version – other numbers for specific consumption, – we would have different numbers, not 15 or 20%. A real mathematical model is necessary, everything must be precisely calculated.

I represent the Supreme Council of Energy Auditors and Energy Managers of Ukraine. We offer assistance in developing such models, a transparent, non-corrupt mechanism for stimulating energy conservation. We hope that the Verkovna Rada will support this. ■

THE STRATEGY NEEDS A STRONGER SCIENTIFIC AND RESEARCH PROFILE

Oleksandr DOMBROVSKYI,
People's Deputy of Ukraine, First Deputy Chairman of the Committee on Fuel and Energy Complex, Nuclear Policy and Nuclear Safety of the Verkhovna Rada of Ukraine

I would like to express my sincere gratitude to the Razumkov Centre for the deep fundamental system-wide approach, which they always apply in the events and documents that they prepare.

Any document, including the Strategy in question, can be supplemented, expanded or, alternatively, narrowed down. To me, a fundamental thing in today's discussion is that this Strategy was created, and we are discussing it in the situation of utmost uncertainty in our country, utmost entropy. Only a year ago, the situation was completely different. But doing strategic things in the situation of unstable foreign currency exchange rate, GDP dynamics, inflation rate, territorial claims existing today, military operations taking place on the territory of Ukraine, – is a very ambitious challenge that the team working on the Strategy undertook.

Today, in conditions of uncertainty, questions are raised to which we must find answers. For example, electric power sector. Electricity production structure is dominated by nuclear and thermal generation. Looking at thermal power industry, – it is not only obsolete, but also its physical wear is so severe that a radical revision of the approach to thermal energy is required. What were the problems that the past month brought? Coal – on the one hand, in the ATO area, thermal power stations – on the other. A problem of coal import arose that we had never had before. Because of relations with Russia, a very serious issue arises concerning nuclear power sector, – fuel, waste, environmental safety, etc. This is why this discussion is essential.

Also, I think it is very important, that one of the first priorities of this Strategy is energy efficiency. I am deeply convinced that it is the **energy efficiency resource that is key to modernising the energy sector**. I always use the example of Poland, which in 1990s had worse indicators than Ukraine. Today, energy efficiency of Poland's economy is approximately 2.5 times better than that of Ukraine. What does this tell us? If we had the same indicators as Poland, we would have consumed almost 2.5 times less energy resources (and our own Ukrainian gas would have sufficed), or our GDP indicator would have been three times higher than the current one, with the corresponding standard of living.

So it is great that recently there has been a lot of talk about energy efficiency and energy intensity of Ukraine's economy. But at the same time, I think that the Strategy needs a stronger scientific and research profile. Energy sector is an engineering industry, technical, technological, therefore, we should take a serious look at energy science, engineering, the use of modern technology. Innovation and technology in the global markets are changing so fast that we lag behind even in monitoring them, to say nothing of implementing.

I believe that today, **industry deprofessionalisation is taking place in the energy sector**. As an electrical engineer, I understand that the energy sector should be managed by people, who understand the industry, energy, know the difference between the Ohm's law and the Kirchhoff's law, and understand that new financial approaches are required.

Regarding the work of the relevant Parliamentary committee and the legal framework. In my opinion, the situation is simpler than what we picture and scare ourselves with. We have obligations to the EU within the framework of the Association Agreement, there are requirements of the Third Energy Package. This is our roadmap, which should guide our progress. Regarding this, the Committee is working on three fundamental (besides others) laws: the Law on the gas market, which aims to profoundly change the situation in Ukraine, create a normal, civilised European market. We also need a Law on the electricity market (here, we should either introduce principal reformatory changes to the current law, or adopt a new one – a dedicated group is already working on this issue). Third fundamental law is the Law on independent regulators, which have been discussed here a lot. **We need an independent, professional and fundamental regulator, which is able to create the rules of the game that no one can change**, because the constant change of rules not only in the energy market, but in the economy as a whole is at present our biggest problem.

To finish my speech. I did not quite understand the World Bank' stand regarding renewable energy sources. Let me explain: in Ukraine there is a firm belief that renewable energy means only solar energy and the "green" tariff. But this is not true. Renewable energy has a huge range of technologies and additional energy resources, – renewable, environmentally clean, cheap (or such that are becoming cheaper today), which we must learn to use. I can name bioethanol, which in Ukraine has been the topic of a futile discussion for 24 years. Today, the world uses second and third generation bioethanol plants that produce energy resources from straw, from grass, – not food. The topic of biodiesel can also be of great interest, incl. biomass. Generating biotechnologies that use bioresources contain unique prospects for us. That is why, we should not cross out the possibilities of RES development

until 2020. Instead, we must strengthen the environmental component of the Strategy, – because if we do not, we will be talking about energy in isolation from environmental issues and the commitments Ukraine has, including to the EU. This is a complex task of great importance that we should undertake together. ■

THE SECTOR'S POLICY HAS TO BE DETERMINED BY SPECIALISTS

Hennadiy RYABTSEV,
Special Programmes Director,
STC "Psychea"

I will not dwell upon the Strategy's content, rather, I will briefly outline the prerequisites for its implementation. In the past 20 years, Ukraine has adopted over 120 strategic documents. Only one of them has been implemented. Which one? – The programme of eliminating Ukraine's nuclear weapons. That situation was caused by the fundamental problems in public administration, which recently only became more severe.

First of all, they include the government bodies losing understanding of energy markets, the idea of national economy as a complex of integral facilities to be managed, as well as transition to management through giving orders.

Second, reactive policy, as opposed to preventive. Government bodies only start to act after the problem gains generic character. They deal with ramifications of a crisis, rather than prevent it.

Third, intensified delay effect in determining the agenda for formation and implementation of state policy.

Fourth, adopting management decisions without the assessment of their effectiveness, efficiency, fairness and practicality; fast and without consideration, under the pressure of public or certain interest groups, on the basis of incomplete, often tendentiously selected information.

Fifth, focus of attention of people, who prepare decisions, on current issues, even though silencing serious problems or smooth-talking about them leads to spending a considerably larger amount of resources in the future.

While participating in drafting the energy Strategy, I faced a conundrum. When the team tried to align the forecasted needs of the country for fuel and energy with its international obligations, it turned out that the mathematical model did not allow it. It looked like in order to implement the already signed agreements, the country had to decommission a large number of thermal power plants, thus reducing the already insufficient maneuver capacities.

Thus, **the fallaciousness of a number of legal acts**, claiming that optimisation of energy balance structure means replacing traditional fuels with other types of fuel, **is indisputable**. Unfortunately, few people are able to recognise this fact. Politicians and government employees, as a rule, are too far away from understanding the concept of "optimisation". The majority uses it only to make a statement about the richness of their vocabulary.

Government bodies still do not experience a need for creating operational and predictive energy balances, devising scenarios for the development of the fuel and energy complex and country's economy as a whole (by the way, scenario forecasts are now substituting scenario models – but they are not given any attention).

Government bodies still do not have standardised, timely, complete, accurate, consistent and coherent information about the real state of the fuel and energy complex. The accuracy of basic information is insufficient for the balance, – the differences in oil product balances published by state statistics authorities are up to 20%. What predictive balances can we talk about based on such information?

Government structures still lack the necessary human resources, – professionals, who are able to implement state policy in the fuel and energy sector. In my opinion, investment bankers, pastry workers and producers of apple concentrate should not shape the industry's policy. Businessmen cannot serve as state officials, as the idea of working in public administration is not to receive income or fight for resources. If we do not solve these problems, the attempts to implement this Strategy, as well as any other, will be futile. ■

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