Lecture №1
The importance of production and use of alternative energy sources in Ukraine

1. The importance of energy for human life and society.
2. World reserves of traditional energy sources.
3. Dynamics of the cost of traditional fuels.
4. The structure of Ukraine's energy consumption and its energy dependence.
5. Socio-economic necessity and socio-economic significance of the development of the biofuels market in Ukraine.
6. Environmental aspects of biofuel production and consumption.

1. The importance of energy for human life and society.

- In physics, energy is the quantitative property that must be transferred to a body or physical system to perform work on the body, or to heat it.
- Energy is a conserved quantity.
- The law of conservation of energy states that energy can be converted in form, but not created or destroyed.

Generalization of existing approaches to the definition of the term “energy security”

United Nations – “energy security” is the continuous availability of energy in various forms, in sufficient quantities and at affordable prices.

The International Energy Agency – “energy security” is the uninterrupted availability of energy sources at an affordable price.

Ukraine’s Energy Strategy for the period up to 2035 – “energy security” is an integral part of economic and national security, a necessary condition for the existence and development of the state. Guaranteeing energy security is achieving a state of technically reliable, stable, cost-effective and environmentally friendly provision of energy resources of the economy and social sphere of the country, as well as creating conditions for the formation and implementation of policies to protect national interests in energy.

Generalization of existing approaches to the definition of the term “energy security”

The methodology for calculating the level of economic security of Ukraine – “energy security” is the state of the economy, which ensures the protection of national interests in the energy sector from existing and potential threats of an internal and external nature, allows you to meet the real needs for fuel and energy resources to ensure the livelihoods of the population and reliable functioning national economy in the regimes of ordinary, emergency and martial law.

Kovalko M.P. – “energy security” is one of the most important components of economic security, which is manifested, firstly, as a state of providing the state with fuel and energy resources that guarantee its full life, and secondly, as a state of security of energy complex and energy capacity to ensure the proper functioning of the economy, energy independence of the country.

Shidlovsky A.K., Vipanasenko S.I., Vorokhov L.P. – “energy security” is a state of providing the state with fuel and energy resources that guarantee its full life; the state of security of the energy complex and the ability of energy to ensure the proper functioning of the economy, energy independence of countries.

Diversification of energy production capacities	Strengthening energy independence from countries importing fuel and energy resources, stability of energy prices;
Price regulation	Energy resources must be available to consumers;
The level of investment in the energy sector	Significant investment is needed to meet projected growth in energy demand, and the availability of this investment can be problematic for developing countries;
Concentration of suppliers	Dependence on imported fuel from a small number of suppliers increases the risk of adverse effects on the market;
Availability of infrastructure examinations	Countries need to have access to different energy sources to achieve different energy mixes;
Possibility to change fuel	Diversification of fuel use can be important for energy security;
Political threats	The energy supply system can be vulnerable to disruptions caused by political interests and terrorist attacks.

Components of energy security systems

Factors threatening Ukraine's energy security

1.	insufficient level of diversification of energy supply sources and technologies;
2.	limited use of own energy potential and new technologies;
3.	excessive dependence on energy imports;
4.	ignorance of market mechanisms in the energy sector;
5.	low fuel and energy efficiency;
6.	criminalization and corruption of the energy sector;
7.	ineffective energy efficiency and energy supply policy.

Generalization of approaches to the definition of the term "energy efficiency" in the works of foreign and Ukrainian scientists

Official document	Definition
1	2
Law of Ukraine "On Energy Conservation" (№ 74/94-VR of July 1, 1994)	Energy efficiency is an activity (organizational, scientific, practical, informational) aimed at the rational use and economical use of primary and converted energy and natural energy resources in the national economy and implemented using technical, economic and legal methods.
Law of Ukraine "On Energy Conservation" (№ 74/94-VR of July 1, 1994)	Energy-efficient products, technology, equipment – products or methods, means of its production that ensure the rational use of fuel and energy resources compared to other options for the use or production of products of the same consumer level or with similar technical and economic indicators.
Law of Ukraine "On Energy Conservation" (№ 74/94-VR of July 1, 1994)	Energy saving (energy efficient) measures – measures aimed at the introduction and production of energy efficient products, technologies and equipment.
European Commission ("Communication on the Energy Efficiency Action Plan")	Energy efficiency – reduction of energy consumption without reducing the use of energy by production and equipment, ie it means the rational use of energy resources and alternative energy sources and reducing the overall demand for energy resources in certain areas.

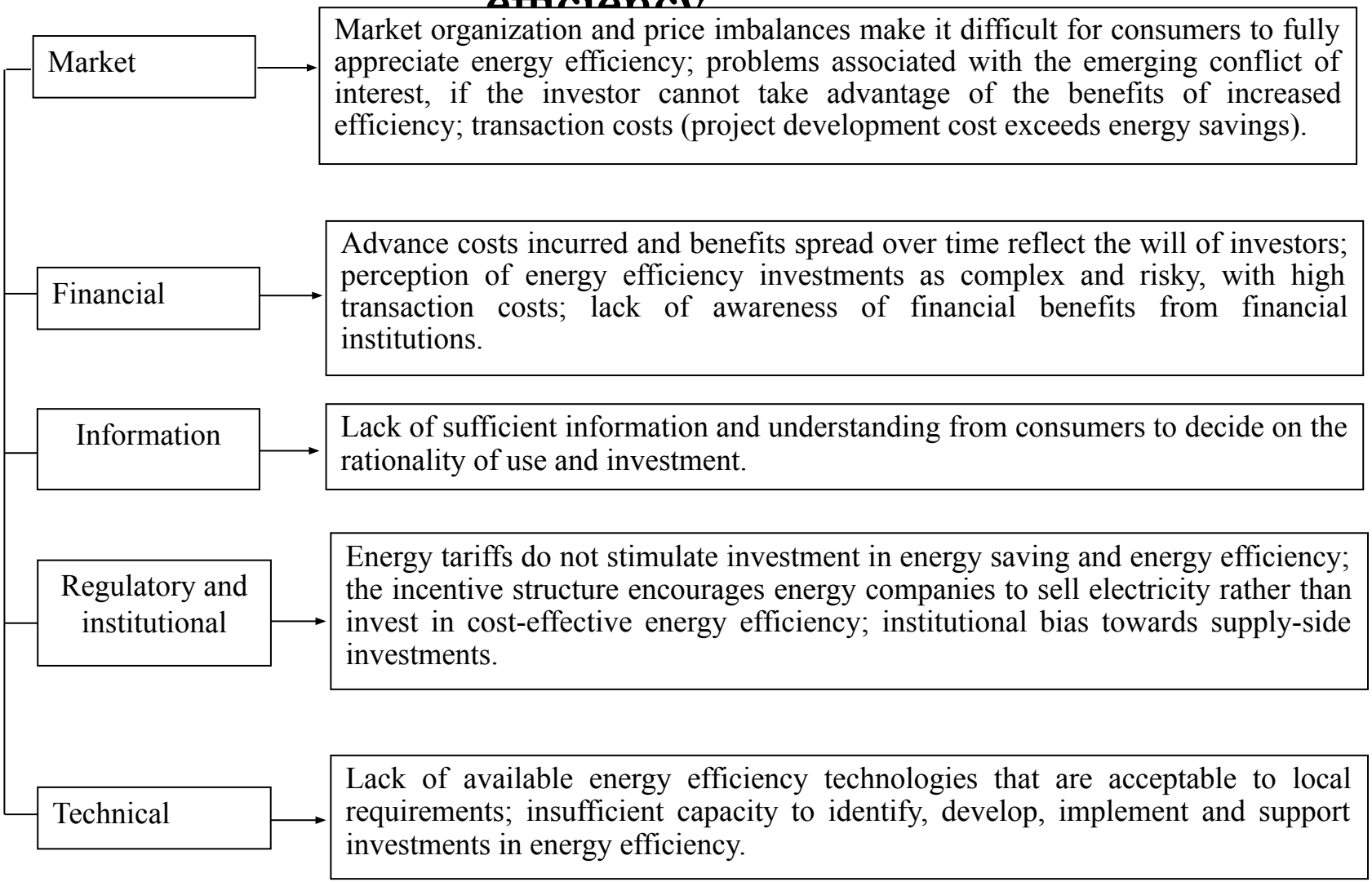
Generalization of approaches to the definition of the term "energy efficiency" in the works of foreign and Ukrainian scientists

Official document	Definition
United States (Department of Energy)	Energy efficiency cannot be expressed by a single indicator, so there are many approaches to its definition or interpretation as a concept: energy efficiency is the necessary level of energy resource consumption to achieve a certain level of well-being (for example, economic, social, human life standards, the state of the natural environment and etc.). Energy efficiency is an indicator that refers to energy intensity, it is a complex system of indicators, the interpretation of which depends on the system for which it is calculated, it is important to monitor the dynamics of these indicators, as well as ensure their dynamic improvement through cost-effective mechanisms (technological renewal and the use of resource-saving technologies).
Institute of Environmental and Energy Research	Energy efficiency means using less energy to perform the same task - that is, eliminating excess energy use.
Federal Ministry of the Environment, Nature Conservation, Construction and Safety of Nuclear Reactors of Germany	Energy efficiency is a measure of the amount of energy required to achieve a particular benefit. The lower the energy loss to achieve a specific goal, the higher the degree of energy efficiency.
Pryshliak N.	Energy efficiency is the rational use of energy resources (traditional and alternative), which is the basis for the formation of energy independence.

Energy intensity of Ukraine's GDP

№	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
GDP, billion international dollars											
1	540,3	569,8	571,2	571	533,6	481,5	492,2	504,4	521,5	538,4	516,7
Final energy consumption, thousand tons of oil equivalent											
2	74004	75852	73107	69557	61460	50831	51649	49911	51458	49359	47821
Energy intensity, t of oil equivalent / thousand international dollars											
3	0,137	0,133	0,128	0,122	0,115	0,106	0,105	0,099	0,099	0,092	0,093
Total supply of primary energy, thousand tons of oil equivalent											
4	132308	126438	122488	115940	105683	90090	94383	89462	93492	89072	86402
Energy intensity, t of oil equivalent / thousand international dollars											
5	0,245	0,222	0,214	0,203	0,198	0,187	0,192	0,177	0,179	0,165	0,167

Classification of barriers to energy efficiency



The main trends in the energy sector of the XXI century.

- Preference will be given to high-quality fuels and efficient use of extensive infrastructure (oil and gas pipelines, powerful and local power systems);
- Developed infrastructure will remain the basis of the energy system, and the need for its expansion will increase;
- Preference will be given to complexes equipped with mechanisms of flexible development;
- The use of oil and gas will be reduced by increasing the share of renewable energy;
- The use of renewable energy sources and the use of biofuels from biomass will be the most important in the market of new technologies;
- The role of decentralized technologies for local energy production will grow, especially in urbanized regions with agricultural development.

Possible threats to the energy security of Ukraine

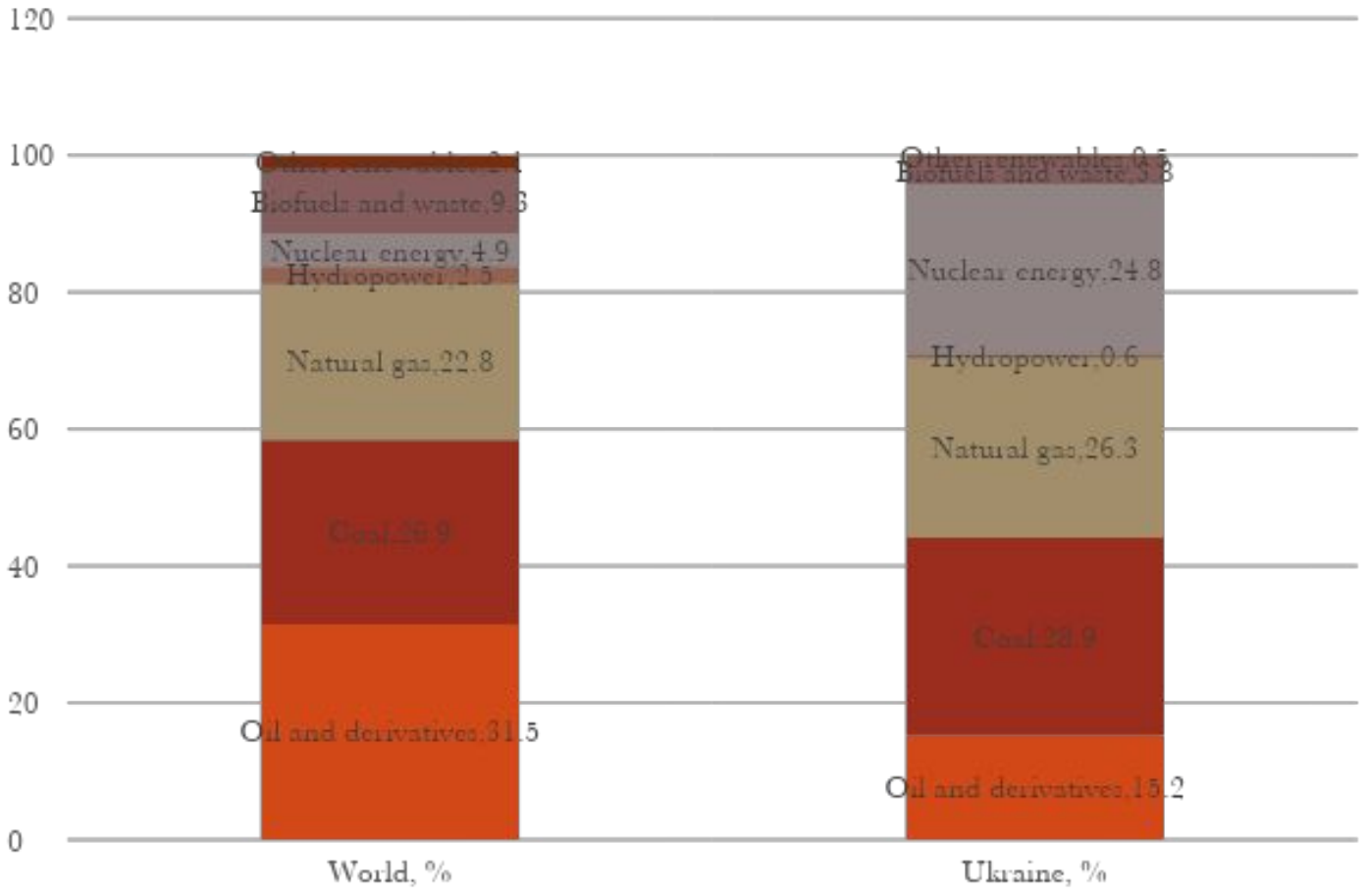
Internal threats

1. Insufficient availability of fossil energy resources;
2. Low efficiency of energy use, which causes their shortage;
3. Depreciation of fixed assets, obsolete equipment, threat of accidents;
4. Increasing social tensions caused by rising energy prices, industrial accidents;
5. Imperfection of state policy in the field of energy efficiency and energy saving.

External threats

1. Variability of prices and conditions of supply of energy resources of the market;
2. Man-made disasters, greenhouse gas emissions;
3. Contradictions in the geopolitical interests of countries, political instability and military conflicts in areas of concentration of energy resources;
4. Lack of effective diversification among energy importers;
5. Climate change, natural disasters.

Structure of world energy consumption (a) and energy consumption in Ukraine (b) by types,% in 2019

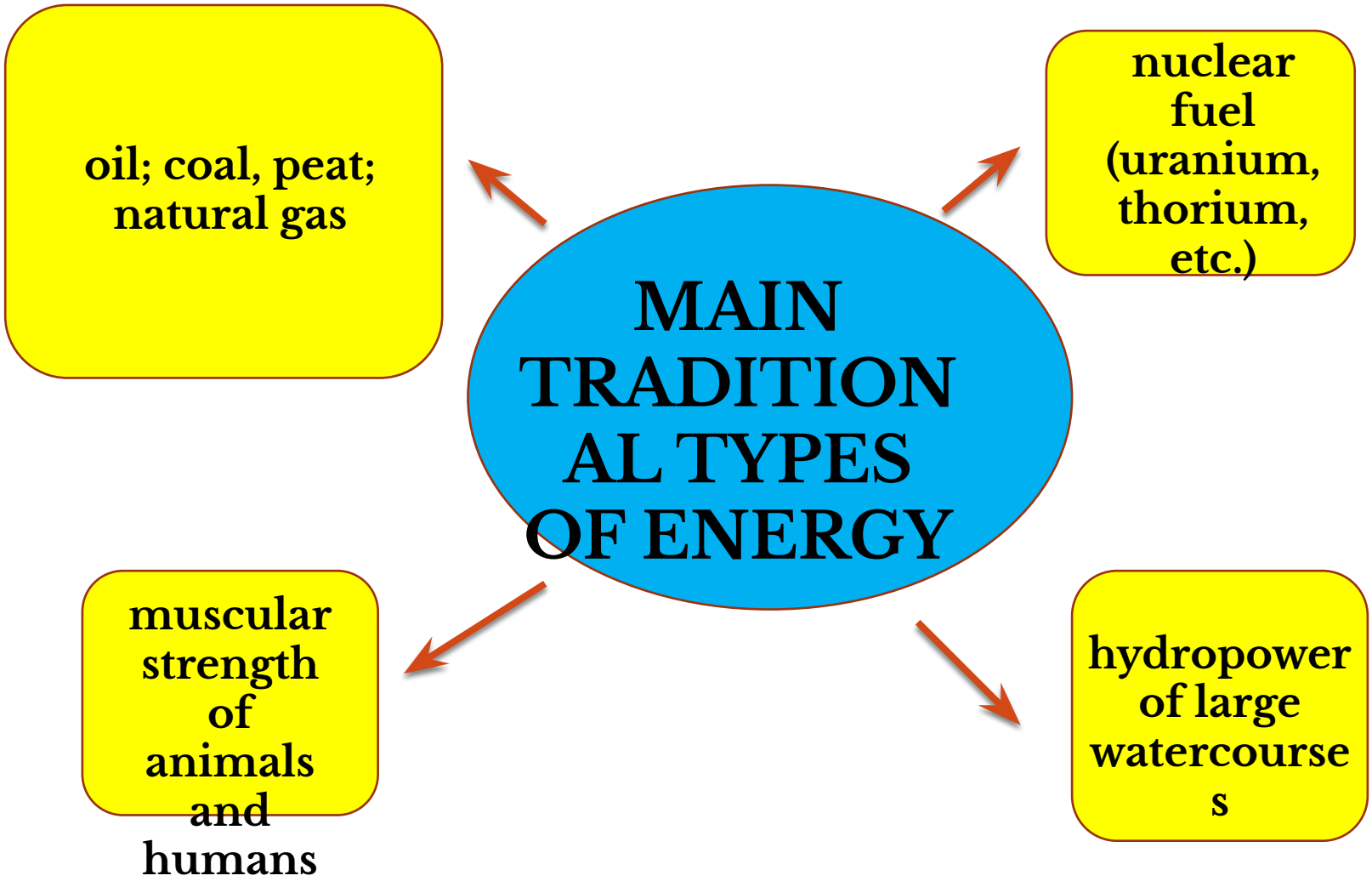


The main directions of improving the energy efficiency of Ukraine's economy should be:

- educating citizens about energy saving awareness, encouraging the use of household appliances and lighting with high energy efficiency;
- reduction of energy consumption of households, commercial and communal sectors for heating needs by increasing the energy efficiency of residential and public buildings, as well as improving the energy efficiency of heating appliances;
- completeness and transparency of accounting for all forms of energy and energy resources;
- improving energy efficiency in the energy production and transformation sector, primarily in the heat and power sector and district heating by optimizing capacity utilization, technical and technological modernization;

- reduction of energy consumption in the systems of transportation and distribution of electricity and heat through technical, technological modernization and conceptual revision of energy supply schemes taking into account the achievements in the field of decentralized energy supply, in particular through the use of RES and energy management;
- assessment of the potential for optimizing the central heating system by switching to individual heating in the regions and facilities where it is economically feasible;
- introduction of the energy management

2. World reserves of traditional energy sources.


MAIN TRADITIONAL TYPES OF ENERGY
oil; coal, peat; natural gas
nuclear fuel (uranium, thorium, etc.)
muscular strength of animals and humans
hydropower of large watercourses

CRUDE OIL IS A FOSSIL SOURCE OF ENERGY, THEREFORE ITS RESERVES ARE LIMITED AND NOT RENEWABLE. UNIVERSITY RESEARCHERS, GLOBAL ORGANIZATIONS AND OIL COMPANIES CLEAR DIFFERENT OIL RESERVES IN THE WORLD AND FORECAST DIFFERENT ON WHEN THEY WILL BE EXHAUSTED.

- **Currently, there are optimistic and pessimistic forecasts about the possible timing of oil depletion. Yes, pessimists believe that this will happen in 20-25 years, optimists point to a period of 50-70 years.**

According to OPEC (The Organization of the Petroleum Exporting Countries), the world's oil reserves are 1.5 trillion barrels.

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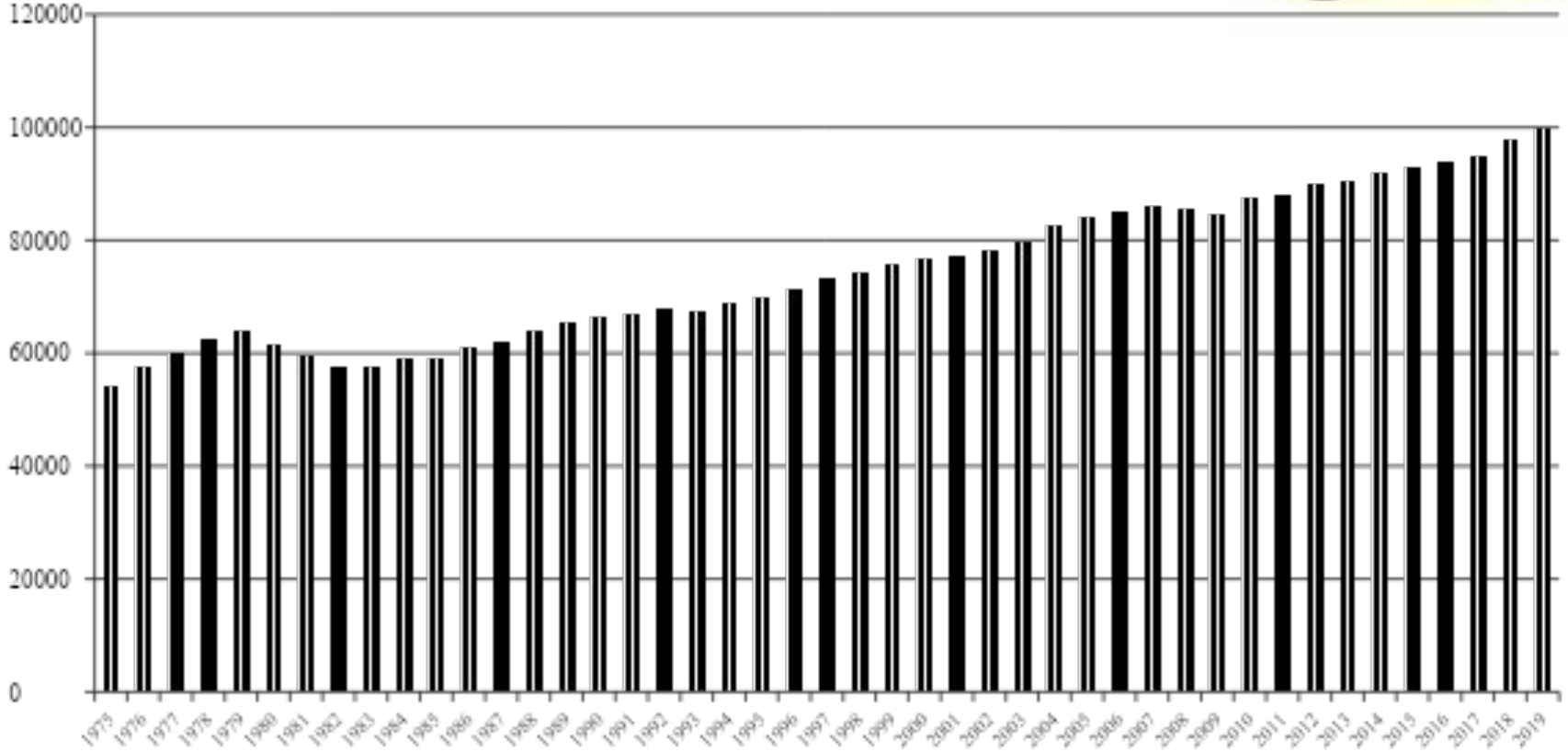
World oil consumption, thousand bar / day. (1 barrel = 159 liters)



Source: based on the Biofuels Platform Statistical Review of World Energy.

Proven oil reserves in the world

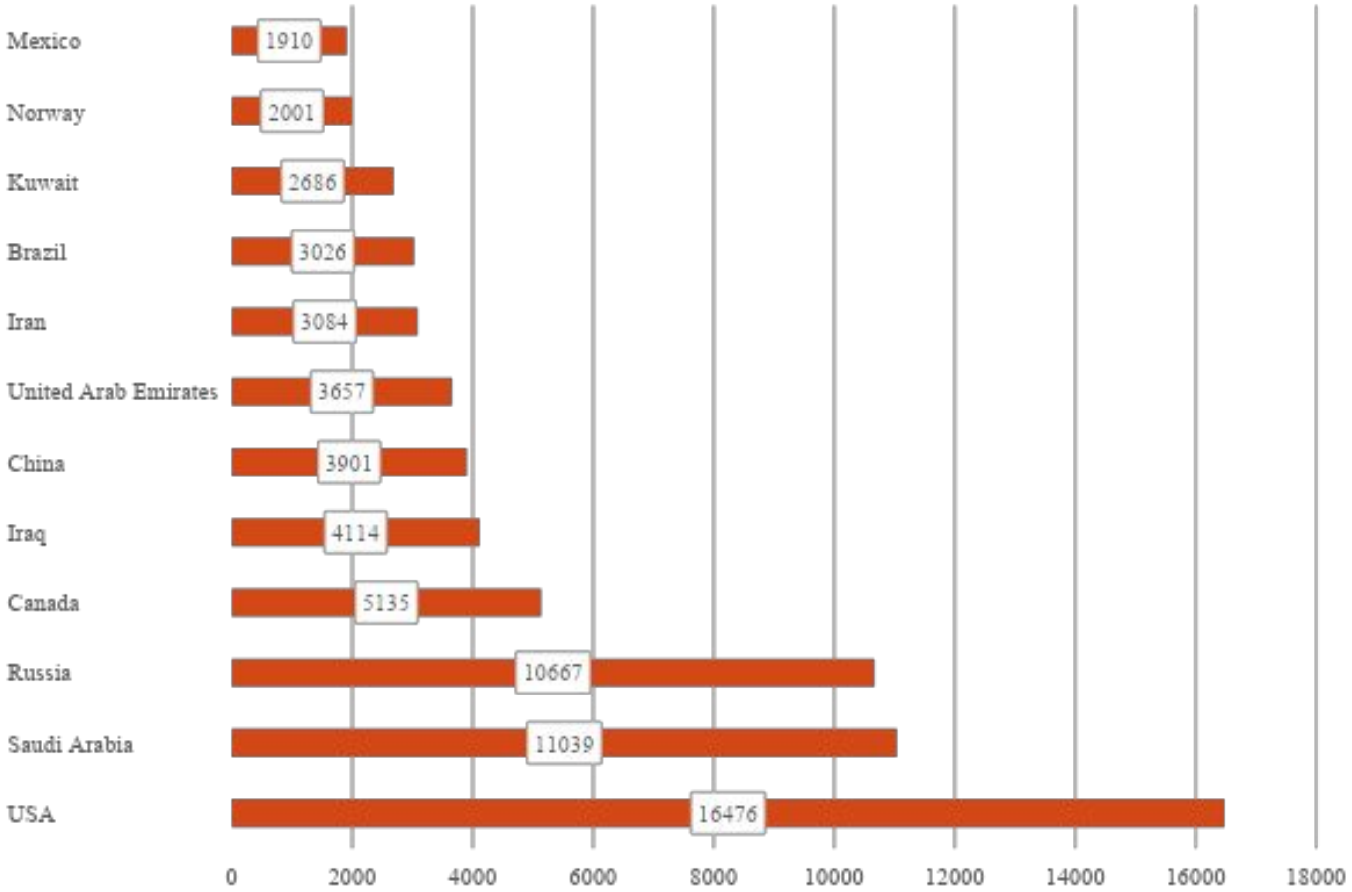
№	Country	Oil reserves, barrels	%
1	Venezuela	299,953,000,000	18.2%
2	Saudi Arabia	266,578,000,000	16.2%
3	Canada	170,863,000,000	10.4%
4	Iran	157,530,000,000	9.5%
5	Iraq	143,069,000,000	8.7%
6	Kuwait	101,500,000,000	6.1%
7	United Arab Emirates	97,800,000,000	5.9%
8	Russia	80,000,000,000	4.8%
9	Libya	48,363,000,000	2.9%
10	Nigeria	37,070,000,000	2.2%
11	United States	35,230,000,000	2.1%
12	Kazakhstan	30,000,000,000	1.8%
13	Qatar	25,244,000,000	1.5%
14	China	25,132,122,000	1.5%
15	Brazil	16,184,100,000	1.0%
51	**Ukraine**	**395,000,000**	**0.024%**

Джерело: BP Plc, BP Statistical Review of World Energy 2020

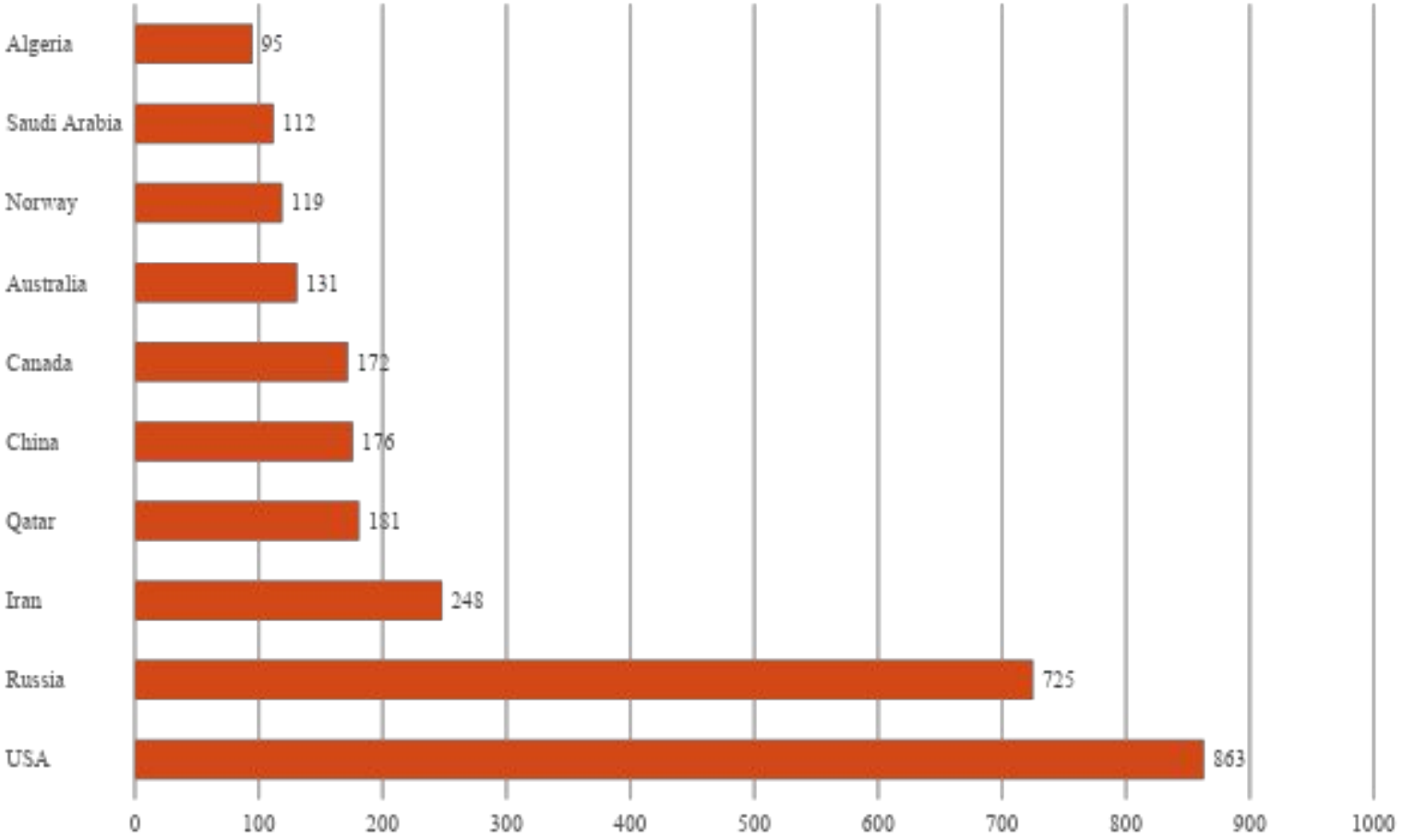
Factors contributing to the growth of consumption of fuel and energy resources:

- development of scientific and technological progress;
- increase in population, vehicles and means of production;
- improving the quality of life, accompanied by an increase in energy consumption (heating, lighting, use of various appliances).
- Thus, according to the Organization for Economic Cooperation and Development (OECD), over the past 10 years, the world's population has increased by 13%, the number of cars by 50%, and transport

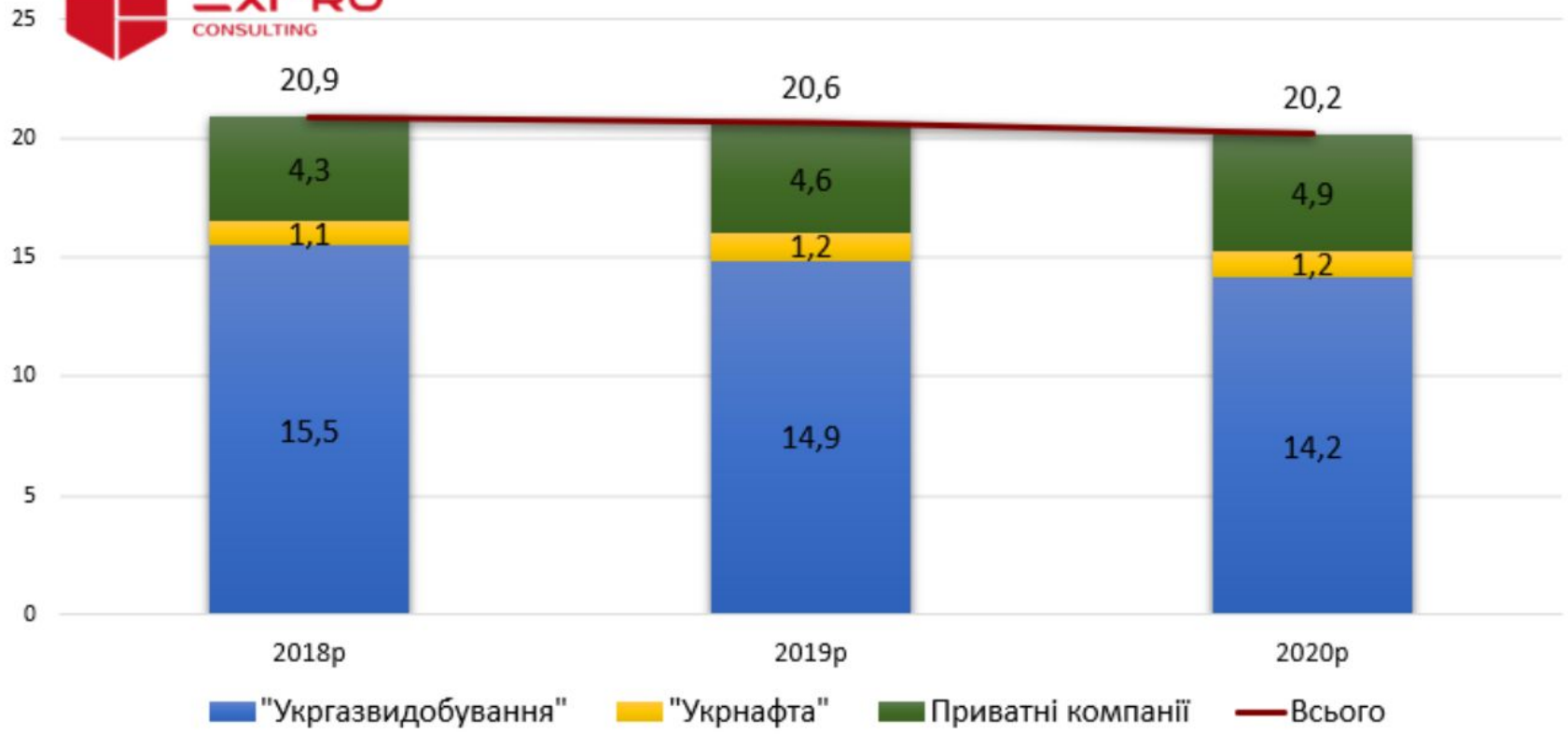
Major countries in world oil production, 2020, thousand barrels / day



The main countries for natural gas production, billion cubic meters (2020)

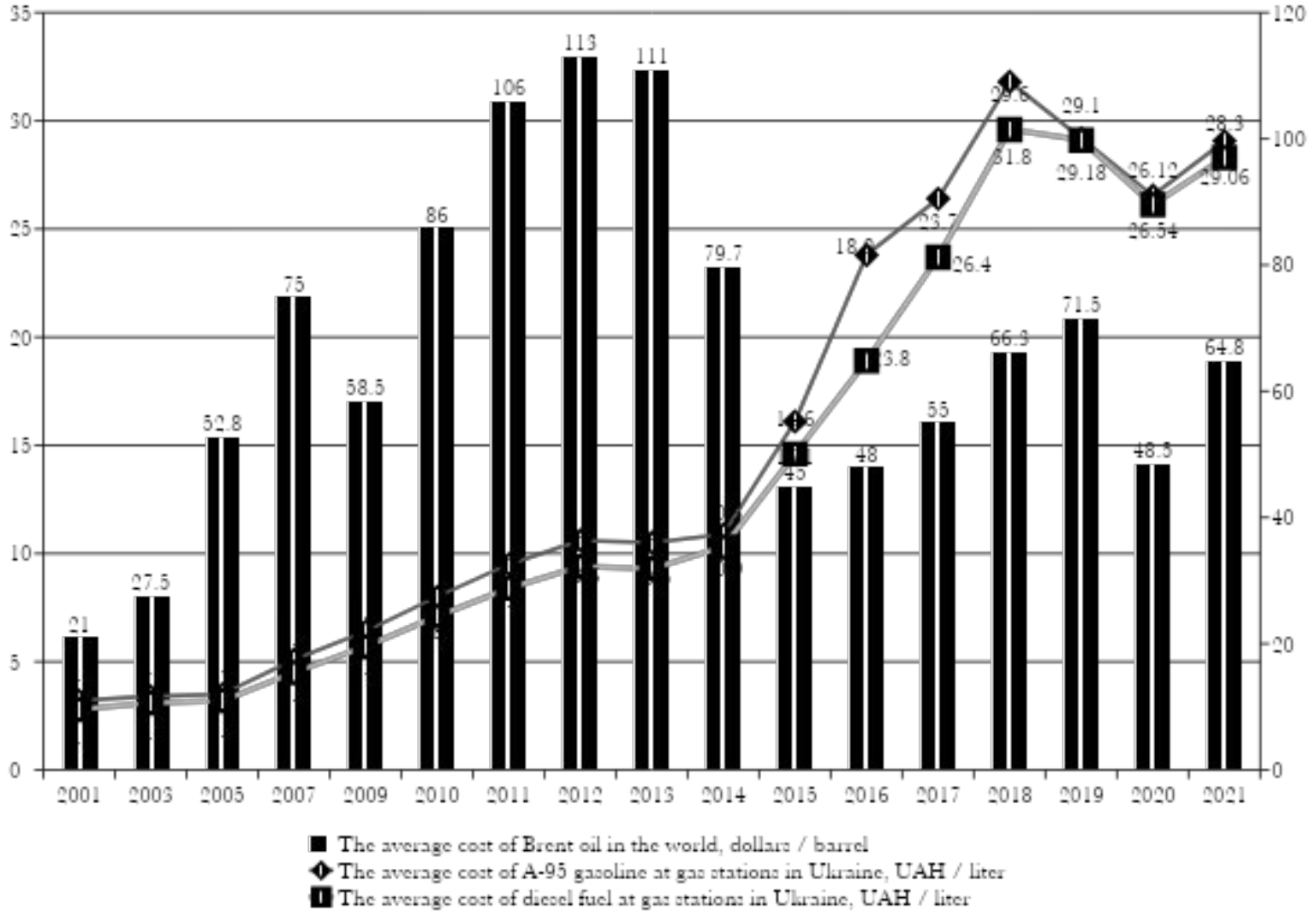


Natural gas production in Ukraine, billion cubic meters

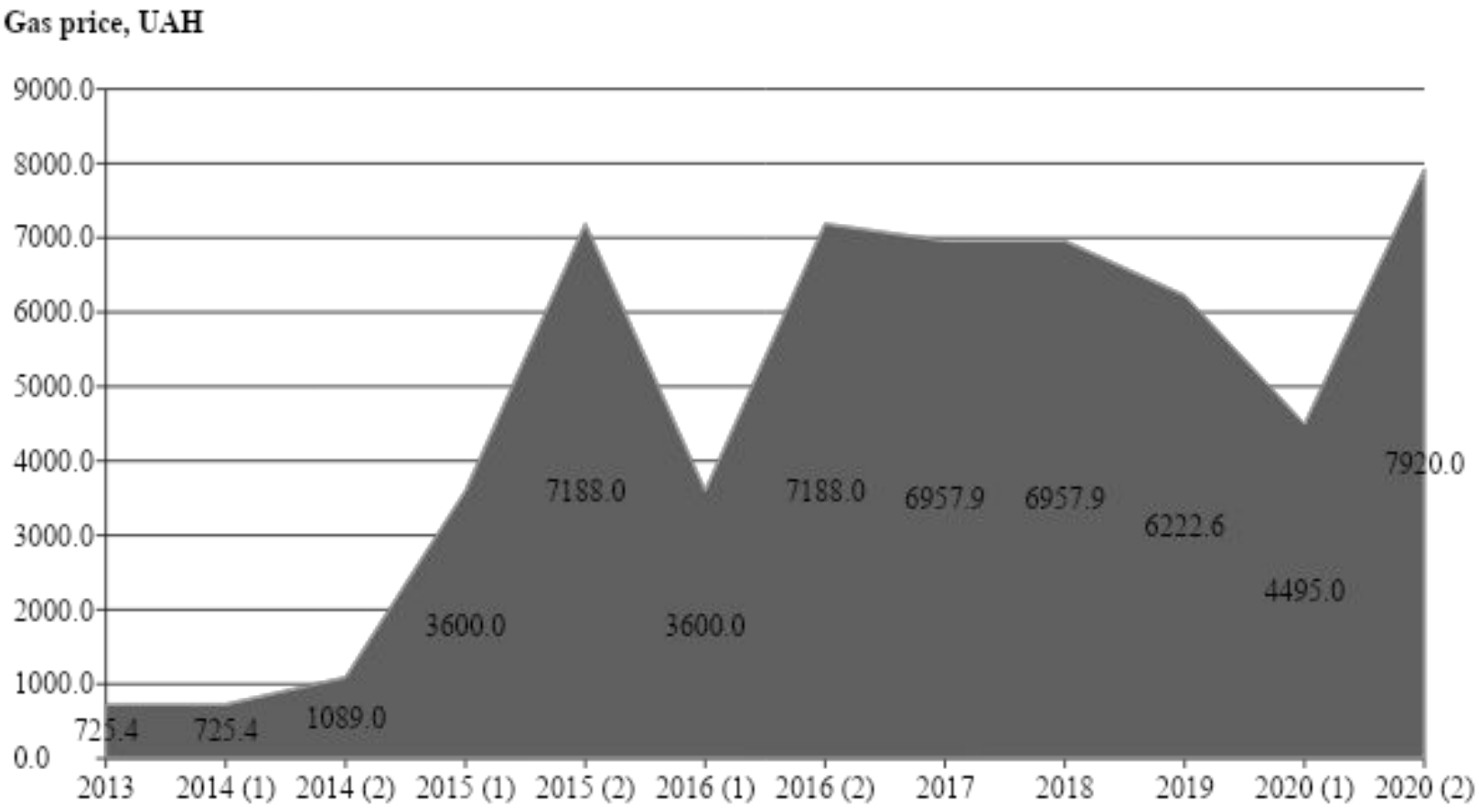


3. Dynamics of the cost of traditional fuels.

Dynamics of world oil prices, gasoline and diesel prices in Ukraine



Tariffs for natural gas for the population on average per year depending on the availability of the meter, the amount of consumption and the accrual period

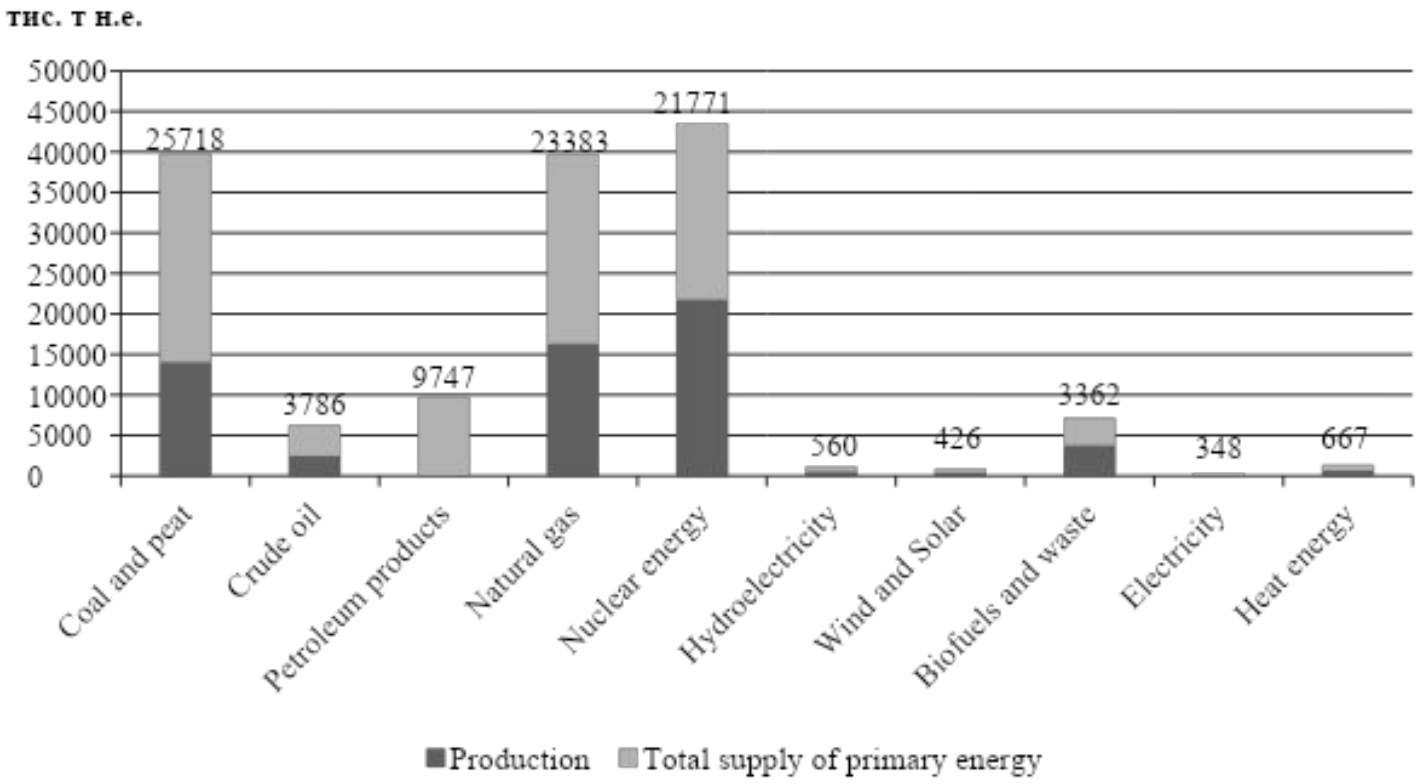


4. The structure of Ukraine's energy consumption and its energy dependence.

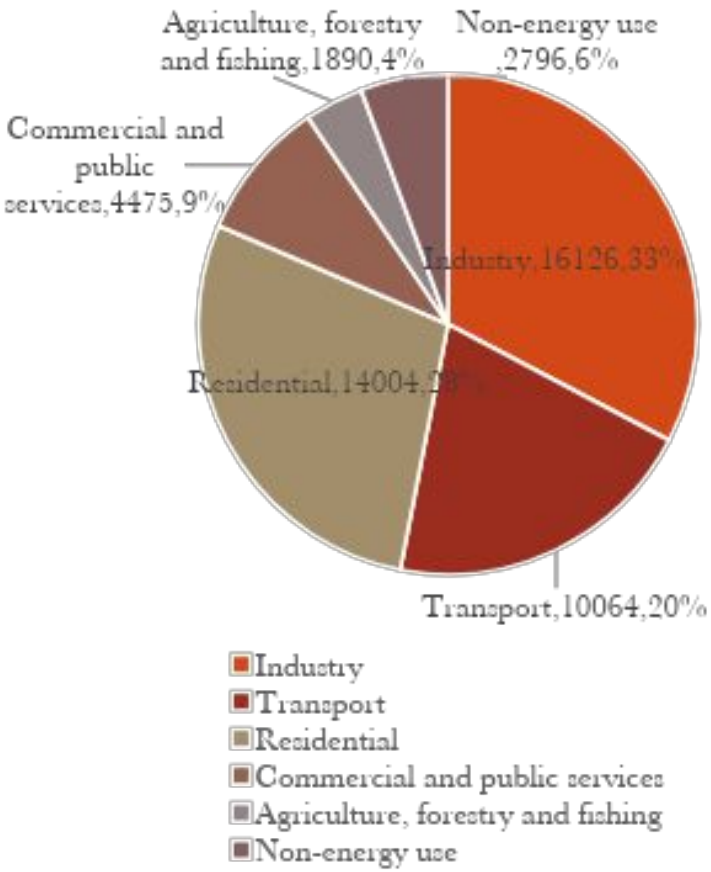
Ukraine is an energy-deficient country. According to the State Statistics Committee of Ukraine, in 2019 the total supply of primary energy in Ukraine amounted to 89072 thousand tons, of which imports - 34768 thousand tons AD. Thus, the energy dependence of Ukraine's economy on energy imports in 2019 amounted to 39%. The structure of imports is dominated by energy resources such as coal and peat (13239 thousand tons AD), petroleum products (10443 thousand tons AD), crude oil (1341 thousand tons AD) and natural gas (9506 thousand tons AD). The deficit of coal reserves is covered by imports from Kazakhstan and the United States, crude oil and light oil products - from Kazakhstan, Kyrgyzstan, Turkmenistan, Belarus and partly from the Baltic countries, natural gas - from the EU.

- Such a structure of energy consumption is economically impractical, creates dependence of Ukraine's economy on oil and gas exporting countries and is a threat to its energy and national security.

Total supply of primary energy in Ukraine and own production in 2019, thousand tons of oil equivalent



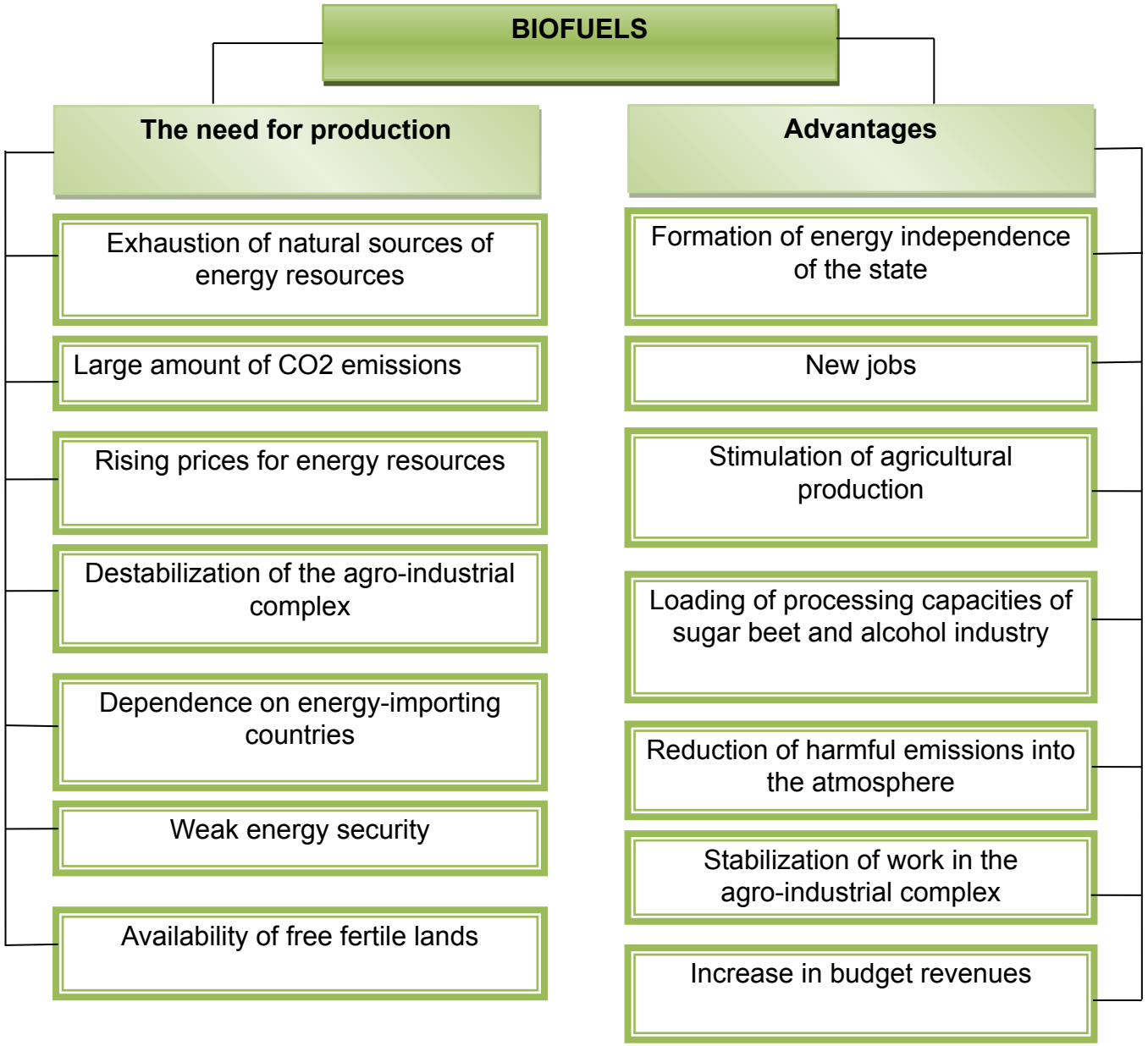
Structure of final energy consumption of Ukraine in 2019, thousand tons of oil equivalent



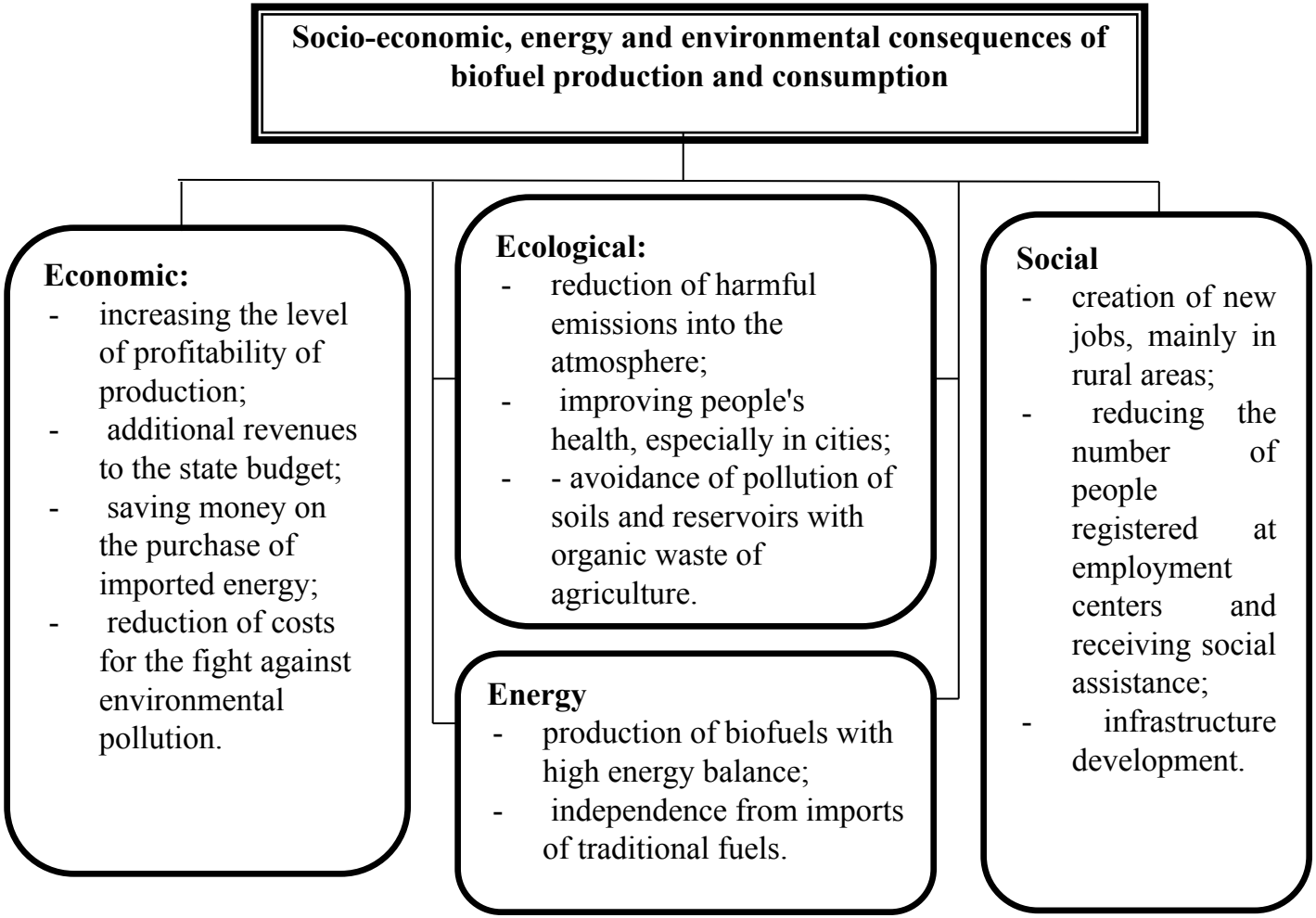
5. Socio-economic necessity and socio-economic significance of the development of the biofuels market in Ukraine.

The main factors that determine the need for production and consumption of biofuels in Ukraine:

- Dependence on energy imports (energy dependence)
- Exhaustion of fossil fuels
- Rising prices for fuel and energy resources
- Deterioration of the ecological situation
- Availability of natural resource potential
- Excessive exports of agricultural products
- Low level of employment in rural areas


BIOFUELS
The need for production
Exhaustion of natural sources of energy resources
Large amount of CO2 emissions
Rising prices for energy resources
Destabilization of the agro-industrial complex
Dependence on energy-importing countries
Weak energy security
Availability of free fertile lands
Advantages
Formation of energy independence of the state
New jobs
Stimulation of agricultural production
Loading of processing capacities of sugar beet and alcohol industry
Reduction of harmful emissions into the atmosphere
Stabilization of work in the agro-industrial complex
Increase in budget revenues

Logical scheme of effects from the production and consumption of biofuels from bioenergy raw materials and waste



6. Environmental aspects of biofuel production and consumption.

Uncontrolled and ever-increasing oil production and the use of petroleum fuels lead to many negative environmental phenomena that threaten our health, economy and the environment, namely:

- climate change;
- formation of acid rain;
- oil spills;
- explosions and fires on oil rigs.

ENVIRONMENTAL BENEFITS OF BIOFUELS:

- **During the combustion of biofuels based on plant biomass, 20-30 times less sulfur oxide and 3-4 times less ash is formed compared to coal.**
- **A by-product in the production of liquid and gaseous biofuels is organic matter.**
- **Reducing the risk of greenhouse effects and, as a consequence, climate change.**

Greenhouse gas - a gas that traps infrared radiation from the earth's surface, leading to global warming on the planet. The main greenhouse gases are: carbon dioxide (CO_2), methane (CH_4), nitric oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulfur hexafluoride (SF_6).

Basic principles of reducing anthropogenic emissions and increasing greenhouse gas emissions

- minimization of adverse social, environmental and economic consequences of anthropogenic greenhouse gas emissions;
- scientific validity, consistency and competence of the approach to reducing anthropogenic emissions and increasing greenhouse gas emissions;
- creation of stimulating conditions for doing business in the field of introduction of environmentally efficient technologies and achievements aimed at reducing anthropogenic emissions and increasing the absorption of greenhouse gases;
- ensuring state regulation of the activities of economic entities in terms of reducing anthropogenic emissions and increasing the absorption of greenhouse gases;
- formation and implementation of state policy and measures in accordance with the national conditions set out in Article 2 of the Kyoto Protocol;
- regulation of greenhouse gas emissions, level of technological processes, technical condition of equipment and facilities in combination with market mechanisms to reduce greenhouse gas emissions and increase their absorption, aimed at economic growth and stimulation of new technologies and innovations;
- ensuring the economic attractiveness of investments aimed at improving environmental efficiency and reducing greenhouse gas emissions;
- use of market relations and competition as one of the main tools to increase environmental efficiency;
- stimulating the development of the energy complex on the basis of bioenergy, transport, utilities, resource-saving production, housing and related services, improving the environmental situation in Ukraine and improving the quality of life.

In the worst case scenario, if greenhouse gas emissions are not reduced, temperatures could rise by more than two degrees by about 2055. And by 2100 it will rise by four degrees.

At the same time, according to research, over the past 45 years, the volume of Arctic ice has fallen by 13%, and sea levels in 100 years have risen by 20 centimeters. In addition, many regions are more likely to suffer from extreme heat, heavy rains and severe natural disasters. Due to climate change, yields are falling and the population of some species is shrinking, both in the ocean and on land.

Recommended Books

- Калетнік Г.М. Виробництво та використання біопалив: підручник. В.: Консоль, 2015. 408 с.
- Калетнік Г.М., Пришляк В.М. Біопаливо: ефективність його виробництва та споживання в АПК України: навч. посіб. К.: Хай-Тек Прес. 2011. 310 с.
- Калетнік Г. М.Біопаливо. Продовольча, енергетична та екологічна безпека України: монографія. К.: Хай-Тек Прес, 2010. 515 с.
- Блюм Я. Б. , Гелетуха Г. Г., Григорюк І. П., Калетнік Г.М. та ін. Біологічні ресурси і технології виробництва біопалива : монографія. К.: Аграр. Медіа Груп, 2010. 403 с.
- Калетнік Г.М. Розвиток ринку біопалив в Україні: монографія. К.: Аграрна наука, 2008. 464 с.
- Блюм Я.Б., Григорюк І.П., Калетнік Г.М. та ін. Система використання біоресурсів у новітніх біотехнологіях отримання альтернативних палив: моногр. К.: «Аграр Медіа Груп», 2014. 360 с.

Recommended Movies