

CONCEPTUAL BASIS OF NATIONAL ENERGY SECURITY AGAINST
THE BACKDROP OF GLOBAL CHALLENGES

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Received ; accepted ; published

Abstract. The article presents theoretical generalization and provides the substantiated solution of scientific and practical problem regarding the development of theoretical and methodological framework for the assurance of energy security of a country. The authors carried out a detailed analysis and specified the leading trends in the world energy market and obtaining resources, researched the distribution of countries in the issue of energy production and consumption, which is fundamental for energy security of a country. They also fostered scientific theories relating to the economic policy of energy sector in the global context, introduced the criteria for assessing energy security of a country. One developed the structure and content of the energy risk management system, which makes it possible to identify and assess the probability of risk occurrence. Matrix for the assessment of energy security risks has been formed. One developed the energy efficiency improvement scheme based on the use of renewables in economy in order to reduce energy consumption and ensure the harmonious development of energy conservation system. The scheme helps to form power management systems, extend the authority of national institutions in matters of energy efficiency and conservation in order to improve energy efficiency of the economy and to reduce energy costs.

Keywords: energy security of a country; energy security capacity; energy resources; energy efficiency and energy conservation; world energy market; energy risks; energy policy of a country

Reference to this paper should be made as follows: Samoilenko, V., Kopytsia, I., Belevtseva, V., Skulysh, Y., Shumilo, O. 2020. Conceptual basis of national energy security against the backdrop of global challenges. *Journal of Security and Sustainability Issues* 10(1), 329-343. [https://doi.org/10.9770/jssi.2020.10.1\(24\)](https://doi.org/10.9770/jssi.2020.10.1(24))

JEL Classifications: F 29, L 94, O 10

1. Introduction

The use of energy is essential to the existence of any country in the modern world. Electric power industry is extremely important for the economy and has a major impact on its sectors, since their normal functioning depend on it. The key to energy security of a country and therefore its sustainable development is reliable, stable, sufficient, cost-effective and environmentally friendly energy supply. Ensuring energy security is hence becoming a priority area for economic and national policies of countries, while changes in the world energy market constantly confirm the relevance of this problem to the entire global community.

Issues relating to the rational use of energy sources, the increase of energy efficiency and security are a prerequisite for the harmonious economic and social progress of the 21st century country. The provision of all spheres of the national economy with different types of energy and fuel is one of the most important tasks of management system, economic policy of a country, fundamental condition for its successful and harmonious development. It is noteworthy that, energy security issue cannot be solved separately by each country (through autocracy or self-sufficiency only). Energy today has an extremely high level of globalization. Thus, there is a definition for the concept of global energy security, which is a complex notion that means not only the reliable provision of the world economy with different types of energy at reasonable prices with minimal losses to the environment (minimal negative impact), but also the safety of the world community and all its members from possible risks and threats to political stability in the world and to sustainable social and economic development, related to both present and future worldwide energy situations.

2. Literature Survey

In the scientific researches of (Baldwin, 1997; Yergin, 2006; Plėta, Tvaronavičienė, Della Casa, 2020), energy security is treated as a feature of the technical security of energy systems. At the same time, the ultimate goal of energy security (according to its definition) is to safeguard a person, society and the state against the shortage of fuel and energy resources. Scientists (Pedroni, 2001; Müller-Kraenner, 2008; Tang, Vijay, 2001; El Iysaouy, El Idrissi, Tvaronavičienė, Lahbabi, Oumnad, 2019) state that, energy security is a system of merging potentials - economic, political, technological, resource and energetic itself, as well as scientific, geographical, organizational, administrative factors and others, which are essential means of any security analysis. Research works by (Johansson, 2013; Karpenko, et. al. 2018) define energy security as one of the components of national security, which shows itself, on the one hand, as the state of providing a country with energy sources for reproduction processes in the national economy to ensure its full functioning, and on the other hand, as the state of security of country's energy system. Such scholars as (Hildyard et. al. 2012; Sovacool and Brown, 2010) note that, energy security appears as a constituent part of economic security concept. It has a targeted impact of the management entity on threats and dangers, the provision of necessary and sufficient conditions to prevent deficiency in supply of affordable fuel and energy resources of acceptable quality by governmental and non-governmental institutions in normal and emergency situations, consistent and efficient implementation of energy conservation and diversification policies, as well as ensuring the effective functioning of energy security subsystem. Researchers (Cantore et. al. 2016; Winzer, 2012) clearly declare that, current energy security is a state of economy that ensures the protection of national interests in the energy sector from existing and possible threats of internal and external nature, enables to meet the real needs for energy and fuel sources in order to provide the vital activity of people and secure functioning of the national economy during the normal regime, state of emergency or martial law.

3. Methods

We consider it appropriate to form the methodological basis of research on the grounds of structural components, theoretical and methodological approaches to the role of energy security in ensuring the competitive advantage of a country in world markets: 1) stabilization method means ensuring energy security in order to achieve the condition of technically reliable, sustainable, economically efficient and ecologically balanced supply of energy resources for the needs of economy and society, as well as facilitating the design and implementation of national protection policy in the field of energy; 2) the systematic approach, which implies that ensuring energy security is a basic need, the crucial task of every country, enterprise and individual households, constitutes the correlation of the following components: development of the fuel and energy complex; satisfaction of economic and social needs for energy resources, taking into account environmental aspects; protection of national interests. In the context of each component, we distinguish quantifiable criteria, which let us define the type of the actual level of energy security and its capacity; 3) the structural approach reveals internal interactions and functional links that form the preceding level by the subsystem of the next level of energy security. Each level of energy security is at the same time an external environment for the previous one and an internal element for the next, therefore forming a corresponding subsystem.

However, the internal environment for the basic level will comprise of factors and aspects caused by the functioning and organization of the subject. At each level, in addition to elements, one should also distinguish their constituent units – the components with their characteristic features, which provide functional interaction between the elements of different levels. Accordingly, the subjects of energy security are institutional and organizational structures, which are created within a separate level to counter external and internal threats.

4. Results

Our goal of research is to define the notion of energy security and its threatening factors, since the clear understanding of the problem root is the first step towards the development of effective state policy in energy security matters.

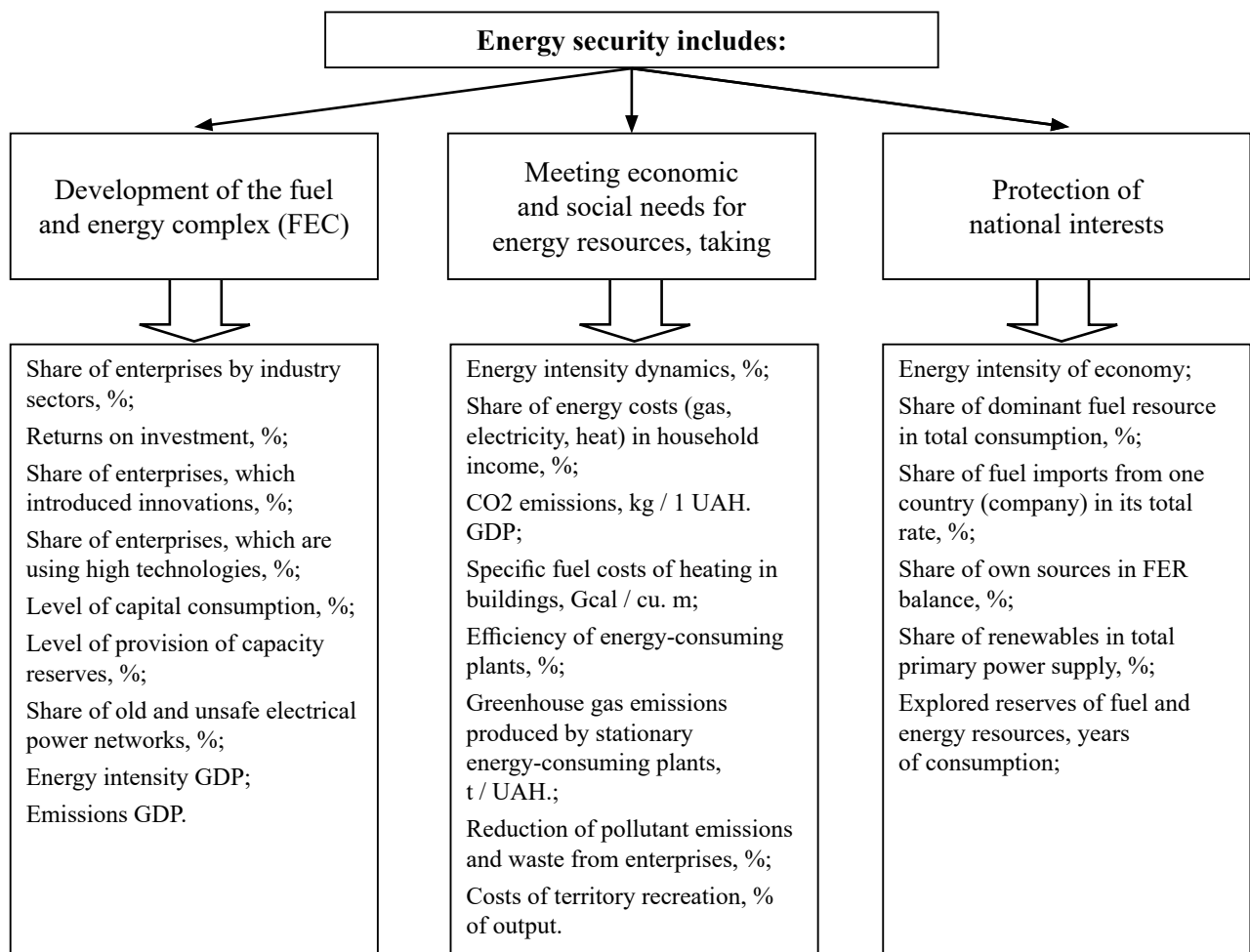


Figure 1. Criteria for assessing energy security of a country (Chester, 2009; Goldthau, 2011; Persson et. al. 2007)

The issue of energy security nowadays cannot be solved separately by each country (through autocracy or self-sufficiency only). Energy today has an extremely high level of globalization. Thus, there is a definition for the concept of global energy security, which is a complex notion that means not only the reliable provision of the world economy with different types of energy at reasonable prices with minimal losses to the environment (minimal negative impact), but also the safety of the world community and all its members from possible risks and threats to political stability in the world and to sustainable social and economic development, related to both present and future worldwide energy situations (Bohi et. al. 1996).

This way, to ensure energy security in the modern sense means to achieve the condition of technically reliable, stable, economically efficient and ecologically balanced supply of energy resources for the needs of economy

and society, as well as to facilitate the development and implementation of the national security strategy in the field of energy (Figure 1).

There is no doubt that, the development of the fuel and energy complex in the economy of the country is extremely important for foreign economic and political relations. To assess energy security of a country or region one uses the system of indicators that reflects its condition and impact of existing threats and factors on it. The quantitative evaluation of energy security is based on analysis of confirmed amount of FER reserves, taking into account their actual production, consumption patterns and efficiency of use. In addition to the mentioned aspects, trends in population changes are also being examined in analytical and expert reviews. Losses of FER during the process impact not only the energy security of transportation and the global amount of resource redeployment, but also the national level of export-import results and the participation of a country or countries and regions in redeployment of resources (Herrerias, 2012). The main indicators of global energy security are shown in Table 1.

Table 1. Key indicators of global energy security during 2006-2018 in dynamics (World Energy Statistics, 2019)

Indicators	2006	2009	2012	2015	2018
Confirmed reserves of crude oil	101.75	102.94	111.9	123.09	131.26
Confirmed reserves of natural gas	103.45	100.05	106.06	107.18	106.89
Confirmed mineable reserves of coal	104.71	109.43	114.14	110.9	95.097
Oil production	101.05	98.486	100.69	101.73	104.27
Oil consumption	99.628	97.803	100.71	101.79	103.01
Oil export-import movements	98.33	94.202	96.321	98.301	99.568
Oil refining	99.501	97.224	99.958	100.57	101.21
Oil-refining capacity	100.91	102.67	103.77	104.21	104.61
Natural gas production	103.76	100.89	108.46	112.39	114.29
Natural gas consumption	102.71	100.4	108.33	110.24	113.04
Natural gas export-import movements	x	x	x	x	100,35
Coal production	103.52	104.46	110.33	117.07	119.75
Coal consumption	101.77	101.22	108.26	113.41	116.57
Nuclear energy consumption	99.55	98.81	100.74	96.558	90.125
Hydroelectricity consumption	103.84	105.28	111.62	113.42	118.61
Other renewables consumption	113.97	131.36	155.97	190.19	219.61
Biofuels production	133.83	149.44	170.94	173.3	173.11
Consumption of primary energy resources	101.34	100.2	105.81	108.31	110.53
Total amount of primary energy production	103.48	105.49	111.66	113.34	115.27
Population	101.16	102.34	103.5	104.66	106.19
Total amount of biofuel production	133.83	149.44	170.94	173.3	173.11
Energy intensity GDP	100.22	101.82	102.65	102.99	101.39
CO2 emissions	100.86	101.82	102.65	102.02	101.39

A In 2018, energy efficiency decreased by 1.6% compared to the previous year, which is 1.39% above its level in 2006 and has a negative impact on global energy security. During 2006-2018, world oil reserves grew by 15 billion barrels due to the increase of officially confirmed reserves in Iraq, which amounted to 6.9 billion barrels. By the end of 2018, 72.6% of all oil reserves were controlled by OPEC member states, who therefore had significant geo-economic impact on the development of the world economy. Coal consumption is projected to reduce to 15.5% (Table 2) within the structure of FER consumption by 2030, but during the analyzed period it grew by 16.5%, while coal production grew by 19.8%. Within this outlook, there was a planned reduction of nuclear energy consumption by 9.1%, which was contributed by EU member countries, Japan and US. At the same time, it caused the growth of hydroelectricity consumption by 18.6% and the consumption of other renewables by 119.6% led by EU and US (Energy Industry, 2019).

Table 2. Share of energy resources in total energy consumption in the world, percentage % (Energy Industry, (2019))

Types of resources	1990	2000	2010	2020	2030	From 2030 till 1990, %
Solid fuel	27.8	18.5	15.8	13.8	15.5	- 44.24
Oil	38.3	38.4	36.9	35.5	33.8	- 11.74
Gas	16.7	22.8	25.5	28.1	27.3	63.47
Nuclear power	12.7	14.4	13.7	12.1	11.1	- 12.60
Renewables	4.4	5.8	7.9	10.4	12.2	177.27

In keeping with modern trends in energy development and green thinking, many countries, especially with strong economy systems, are increasingly focusing on non-traditional (including renewable) energy sources. Such approach has the double benefit, in particular: 1) diversification of energy sources, which ensures high level of energy independence and security of the country; 2) meeting the “greening” requirements of energy sector and reducing the level of greenhouse gas emissions into the atmosphere (which cause irreversible, negative climate changes on Earth) (Ciupageanu et. al., 2019; Drobyazko et. al., 2020).

The European Union states hold leading positions in the implementation and use of unconventional energy. According to the database of January 1, 2020, four countries from the European Union reached the top ten of G-20 (countries of the top twenty) in terms of share of nonconventional power source usage (Germany - first place, Italy – 3, United Kingdom - 5, France - 6). Despite the fact, that EU shared the top 5 positions only with Indonesia, since the second place was occupied by the European Union itself (27 countries). The USA ranked seventh in that rating, Mexico – 8, India – 9. One should take into account, that European countries non-members of G-20, where this indicator was even higher, were not included in the list (Norway, Sweden, Finland (BP Statistical Review of World Energy 2019: an unsustainable path, 2019).

Analyzing the trends in the development of renewable energy sources shows that, European countries had a special interest in non-conventional energy much earlier than other countries of the world (Cheon, Urpelainen, 2014). The evolution of this indicator within twenty years (1991-2018) displays gradual growth of the share of electricity, which is produced by renewable energy sources, in the total energy consumption by EU countries (Figure 2).

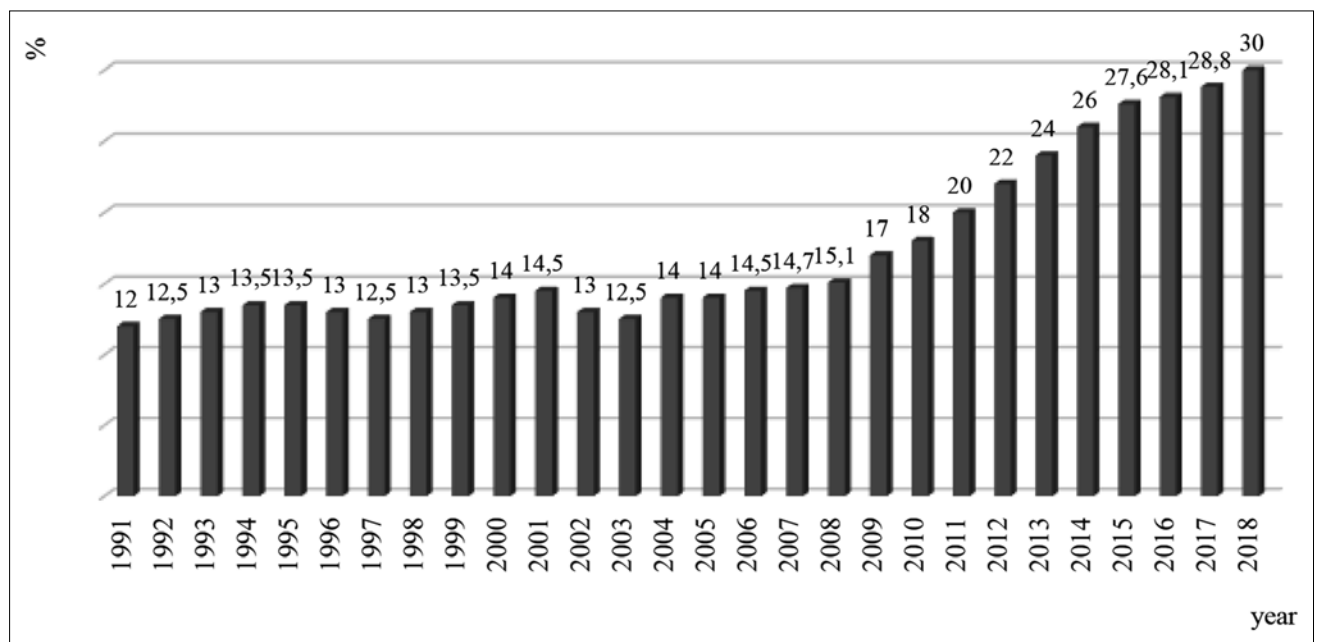


Figure 2. Share of renewable energy in total energy consumption by EU countries during 1991-2017 (BP Statistical Review of World Energy 2019: an unsustainable path, 2019)

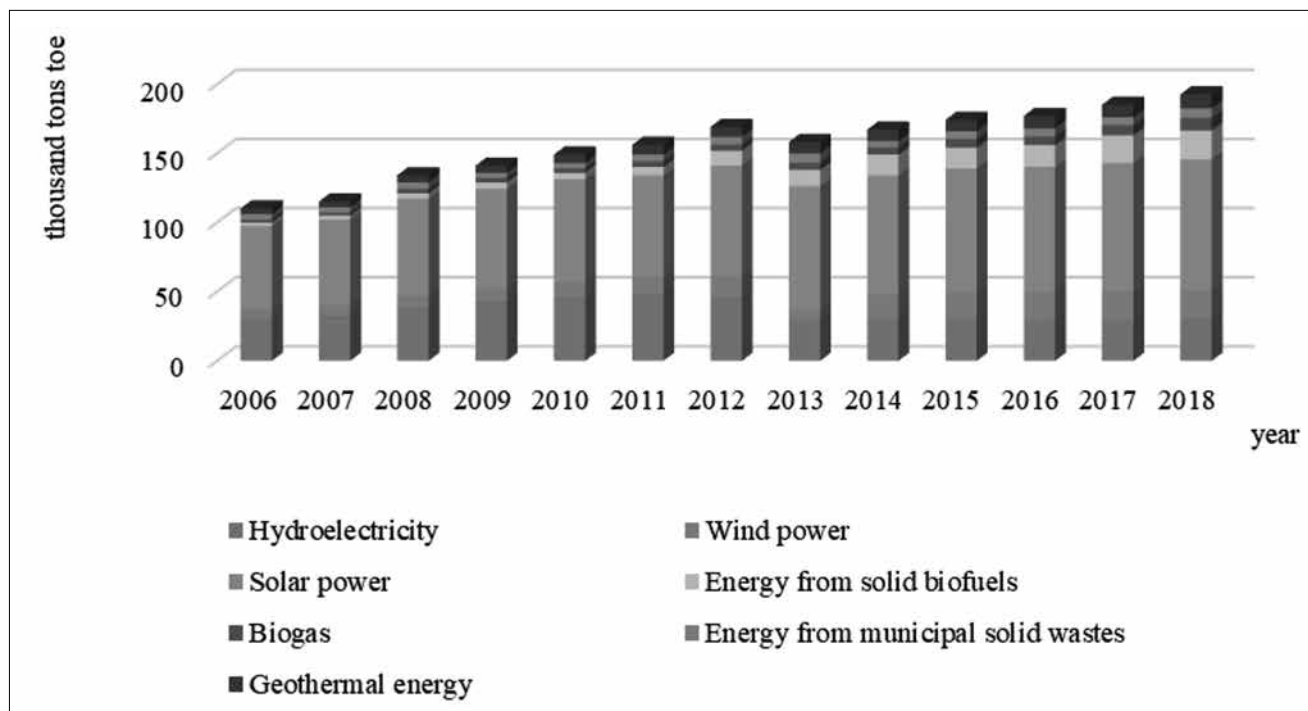


Figure 3. Structure of primary energy produced by basic renewable resources in EU countries during 2006-2018 (BP Statistical Review of World Energy 2019: an unsustainable path, 2019)

In 1990, this indicator exceeded 10%, and after 2017, it doubled. Studies have shown that, European countries are not going to relax their efforts, as they ambitiously maintain investments in “clean” energy. In 2018, EU countries ranked third under this indicator behind China and US. The main part of primary renewable energy production in EU countries is derived from biomass and waste products (Figure 3).

As to biomass, the attitude to it has changed lately, since the cultivation of energy crops needs land that can be better used for growing agriculture plants. It is considered ineffective in the context of upsurge in food costs and their shortage. However, the use of straw, wood and other wastes of economic activity still remains beneficial. Analyzing the data available on the Eurostat website, one can conclude that, the largest contributors to the growth of primary renewable energy production from 2000 till 2015 were Belgium (+ 272%), Germany (+ 260%), Slovak Republic (+ 182%) and Ireland (+ 164%) (Lazaroiu, Ciupageanu, 2019).

For comparison, the average growth across all EU countries is only + 72 %. In terms of absolute changes, during the analyzed period, production in Germany grew by 23652 thousand tonnes of oil equivalent (according to the decision of the International Energy Agency (IEA), oil equivalent is taken as a unit of fuel equivalent and indicated by “ toe”, 1000 toe is equal to 1 ktoe), in Spain - 7729 ktoe, in Italy - 6730 ktoe, in France - 4919 ktoe. The total growth within the European Union is 70 000 ktoe. In spite of the fact that, the value of alternative energy is growing worldwide, the share of its production, as of 2018, was driven only by a few countries: USA, Germany, Spain, China, Brazil (Figure 4) (World Atlas Fact Dataset, 2019).

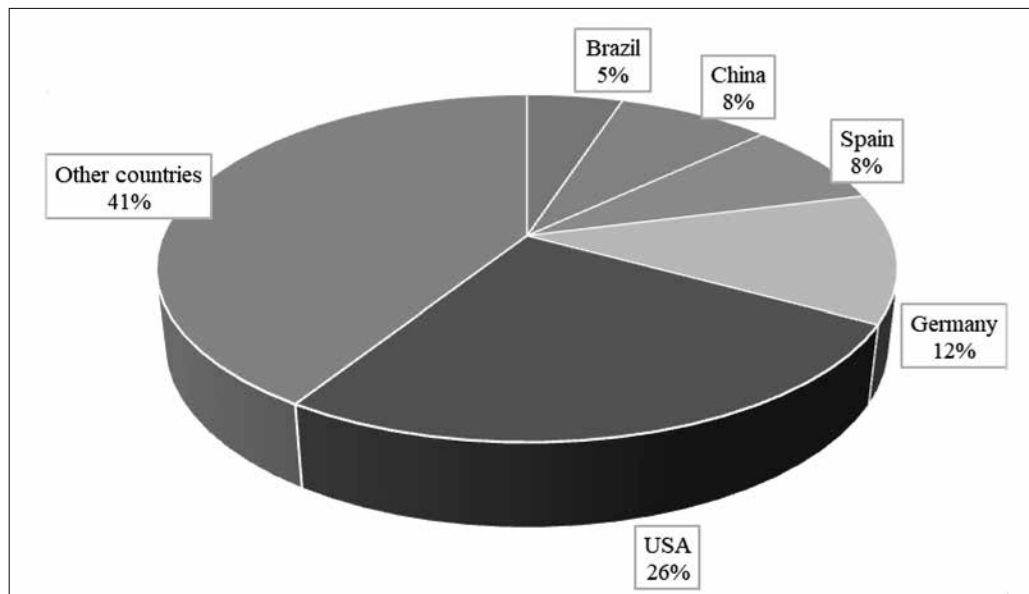


Figure 4. Structure of alternative energy production by countries in 2018
(International Energy Statistics - International - US Energy, 2019)

Recently, the world has witnessed increased investment in “clean” energy. In terms of investment during 2005-2018, the European Union took the first place (290.68 billion US dollars in total, from them Spain invested 77.47 billion US dollars, Germany - 49.35 billion US dollars, United Kingdom - 45.42 billion US dollars, Italy - 24.28 billion US dollars, France - 20.842 billion US dollars). They were closely followed by: The United States of America (214.96 billion US dollars), China (197.49 billion US dollars), Brazil (52.31 billion US dollars), India (39.72 billion US dollars), Canada (23.88 billion US dollars), Australia (10.31 billion US dollars), Japan (9.41 billion US dollars), Mexico (6.03 billion US dollars), Turkey (5.57 billion US dollars). In total, G-20 invested more than 860 billion US dollars in alternative energy within the analysed period. In 2018, the top countries in terms of investment were China (49.74 billion US dollars), followed by the United States of America (44.51 billion US dollars) and members of the European Union (38.71 billion US dollars), then India (10.13 billion US dollars) and Brazil (8.23 billion US dollars). Thus, one could observe the steady growth of alternative energy investing by G-20. In 2011, these countries invested about 160 billion US dollars in total (Atalla, Bean, 2017; International Energy Statistics - International - US Energy, 2019).

To sum up the results of the research regarding the development of alternative energy in the world, we can state the following: taking into account all problem issues of conventional energy sources (exhaustibility, environmental pollution, constant rise of prices for energy resources and so on), the gradual transition of mankind to alternative sources, which are still quite expensive but more importantly renewable, is considered to be the best option. Renewable energy sources have already successfully replaced conventional energy sources in some countries almost completely (Norway, Ireland, Croatia, etc.) (Gielen et. al. 2019; Herran et. al. 2019; Tvaronavičienė, & Ślusarczyk, 2019).

The positive outcome of liberalization process in the European electricity market, which followed the adoption of the first European liberalisation directive (transposed into German and Austrian legal systems in 1998, into French – in 2000), was development of power exchanges that were able to involve a wide range of participants: power generation and energy producing companies, large electricity consumers, investors, traders, etc. As a result of liberalization, energy trading provided by exchange markets appeared to be very segregated. In total, more than 15 energy exchanges and trading platforms, which have substantive differences in their structure, have appeared on the continent (EEX, Nord Pool, OMEL, EXAA, Belpex, Powernext) (Table 3).

Table 3. Description of the principle functions of the leading European energy trading platforms

Names	Brief description	Key functions of exchanges and operators
Nord Pool (The Nordic Power Exchange)	The only multinational energy exchange in the world. Established as Electricity Market Operator of Norway in 1993. In 1996, the Swedish energy market was integrated into the power exchange. It also merged with the Finnish exchange in 1998 and with East Denmark exchange in 2000.	Contract trading: power delivering (Nord Pool Spot AS); balancing hour-ahead market; futures contracts; forward contracts (annual, season, monthly, weekly); options; over-the-counter swaps; «for difference in asset value» (Contracts for Difference — CfD); CO2 European emission allowances; system services. Nord Pool Consulting offers market data services to exchange participants.
OMEL (Operadora del Mercado Espanol de Electricidad)	Iberia Electricity Market Operator – Spanish Pool. It is Spanish electricity market operator, where selling 100% of electricity through the intermediary of OMEL is required.	Contract trading: system service contract trading; trading in financial derivatives (futures, forwards, options); energy trading (day-ahead market, balancing hour-ahead market). Providing financial settlement between market participants. Providing market participants with relevant market data. Electricity demand forecasting. Coordination of production capacity utilization. Providing entity control of compliance with market rules and contract matters. Ensuring the principles of independence, transparency and objectivity in the market work.
EEX (European Energy Exchange)	The German Exchange, which was founded by unification of Leipzig Power Exchange and Frankfurter European Energy Exchange in 2002. Acts as a central participant of each agreement in the wholesale and futures electricity markets, undertakes individual risks of bidders.	Contract trading: energy trading (day-ahead market) — spot; derivative trading (futures and options); forward contracts (annual, season, monthly, weekly); over-the-counter swaps; system service contracts; CO2 emission allowances. Providing clearing services in the process of over-the-counter transactions (OTC Clearing).

As long as the fundamental energy price-setting criterion is the level of market liquidity (the higher the liquidity is, the lower prices are), there is a great competition caused by low liquidity of energy exchanges, which operate with doubtful advantage. For instance, the German market is above than three times more liquid than the French market (this led to the fact that, energy prices in France were higher than in Germany) (Scheepers et. al. 2007).

In the markets of Western Europe, energy price is determined not only by its working cost or type of generation, but also by market size and the number of its participants. In 2004, the European Commission advocated for the regional principle of power exchange activities, thus hoping for the effective integration of separate segregated markets. In particular, energy exchanges of Germany and France established close cooperation (for instance, European Energy Exchange (EEX) and Powernext). The power exchange EEX appeared through the unification of Leipzig Power Exchange and Frankfurter European Energy Exchange in 2002. It is now the largest energy exchange in continental Europe with more than 187 participants from 20 countries (Kruyt et. al., 2009).

In the world economic system, energy is considered to be the most influential factor in its security, prosperity and development. Energy demand has an explicit rising tendency even in the context of energy-saving programs, especially in highly developed countries (China, India, Brazil). Overall, energy security risks can be said to have global nature and significantly affect (in negative or positive way) the state and development of national and world economies (Sovacool and Khuong, 2011; Chehabeddine, Tvaronavičienė, 2020).

In our opinion, it seems appropriate for energy market entities to refer to risk management methodology and to carry out systematic risk research and analysis while developing and implementing energy policies. Let's

examine statistical methods for risk analysis in detail (Checchi et. al., 2009). Assuming X – a discrete random variable $X = \{x_1, x_2, x_3\}$, where x_1, x_2, x_3 – potential consequences of the event by optimistic, moderate and pessimistic estimates, and the probability of their occurrence $P = \{p_1, p_2, p_3\}$, then mathematical expectation $M(X)$ of potential consequences will be:

$$M(X) = \sum_{i=1}^3 p_i x_i; \sum_{i=1}^3 p_i = 1 \quad (1)$$

Mathematical expectation $M(X)$ can be considered as an average-case expected risk. Also, an important absolute indicator of risk is represented by the standard deviation (root mean square deviation) $\sigma(X)$, as a measure of the scattering (variance) of potential losses around the mean $M(X)$:

$$\sigma(X) = \sqrt{\sum_{i=1}^n p_i [x_i - M(X)]^2} \quad (2)$$

The coefficient of variation V serves as the relative risk indicator. It can be calculated by using the following formula:

$$V = \frac{\sigma(X)}{M(X)} \times 100\% \quad (3)$$

Conceptually, when making assessment of absolute and relative risk indicators, any deviation from the mean is considered undesirable. According to the neoclassical theory of risks, only adverse variances are taken into account. In this case, risk is assessed by modified indicators: absolute value of semivariation (V_s) – as an analogue of mathematical expectation $M(X)$; absolute value of the seven-squared deviation (V_{ss}) – as an analogue of the standard deviation $\sigma(X)$; relative value of semivariation (V_{ks}) – as an analogue of the coefficient of variation V . The use of the given absolute and relative indicators makes it possible to quantify the level of risk and thereby define the main areas for targeted response (impact) to it. Table 4 shows the scale for the assessment of negative risk impact (unilateral scale) on the achievement of such goals: stability of energy supply, safety of operational activity, financial and economic efficiency of activity.

Table 4. Scale for the assessment of negative risk impact on the achievement of energy security goals

The impact of risk on energy security	Qualitative / quantitative risk impact assessments				
	Very low, LL	Low, L	Medium, M	High, H	Very high, VH
	0.05	0.10	0.20	0.40	0.80
1. Instability of energy supply	Barely visible	Less than 5%	Range of 5-10%	Range of 10-20%	More than 20%
2. Danger of operational activities	Minor	Requires routine-preventive actions	Requires operational impact	Requires confirmation of expediency	Activity loses expediency
3. Deterioration of financial and economic results	Imperceptible	Less than 5%	Range of 5-15%	Range of 15-40%	More than 40%

To rank risks on two criteria (probability / impact) energy security risk assessment matrix is used (Table 5). The relative coefficient of partial risk (K_r) can be calculated by using the following formula:

$$K_r = p \times V \quad (4)$$

where p – is the probability of risk occurrence;
 V – risk impact assessment.

Table 5. Matrix for the assessment of energy security risks

Probability	Level of impact				
	Very low, LL	Low, L	Medium, M	High, H	Very high, VH
	0.05	0.15	0.25	0.45	0.85
0,95	0.05	0.09	0.2	0.35	0.73
0,77	0.04	0.07	0.15	0.29	0.55
0,5	0.03	0.05	0.11	0.21	0.41
0,35	0.02	0.03	0.07	0.13	0.23
0,15	0.01	0.01	0.019	0.038	0.078

The matrix identifies areas of risk based upon the value of the coefficient Kr: 1) low-risk area - up to 0,075; 2) medium risk area – Kr ∈ [0.075; 0.25]; 3) high-risk area– more than 0.25.

The policy of energy market relations should be designed not only upon the results of risk identification, assessment and risk management strategy, but also upon the plan of risk responses and control (monitoring) methods. Risk responses (partial, general) should be timely, adequate, clear to stakeholders and effective. The purpose of responding to risks is taking the necessary measures to reduce the level of potential threats, provide rational use of possibilities, as well as to lower the costs of certain risk events (Makedon et. al., 2019).

Global energy security is represented by international organizations, institutions, associations of countries and their unions; energy security of a country – by state institutions and organizations in the field of energy security, representative offices of international supervisory bodies; energy security of a region - by institutions and organizations of local self-government authorities, associations of economic entities, public organizations, etc.; energy security of an entity (local energy security) – by entities of different ownership forms and their functional units, citizen groups, non-profit institutions and organizations, as well as their departments, separate households. It is important to note that, the actual level of energy security is formed under the influence of the above-mentioned FEC development criteria and the ability to meet economic and social needs for energy resources. However, if the level of actual energy security is high, the enterprise is able to fully maintain its functioning, otherwise there may appear problems, which can lead to folding operations (Gnansounou, 2008). If the range of threats, under which the country still provides its development, is wide, then it has high energy security capacity, which for its part, makes the economy system able to progress in adverse conditions. In view of the above, the matrix of energy security classification based on actual level and capacity will be presented (Figure 5).

Actual level	Capacity	
	Increasing	Decreasing
Increasing	Sustainable security	Unsustainable security
Decreasing	Unsustainable security	Critical danger

Figure 5. Matrix of national energy security types

The combination of actual level dynamics and energy security capacity makes it possible to distinguish three types of economic security of the country, such as sustainable security, unsustainable security, critical danger (von Hippel et. al., 2009). The scheme for promoting energy security and improving energy capacity of the national economy is presented in Figure 6.

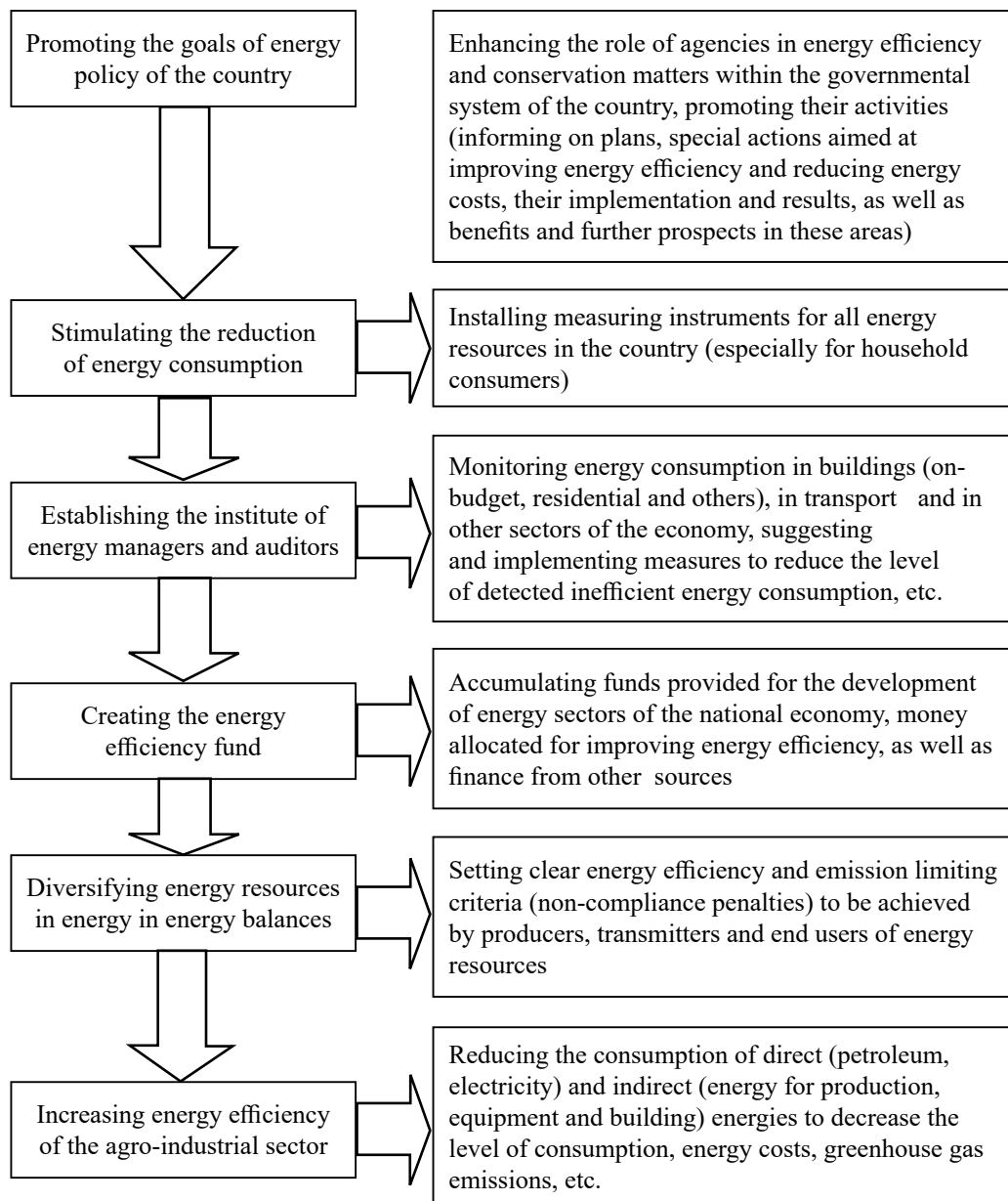


Figure 6. Scheme for promoting energy security and improving energy capacity of the national economy

The combination of actual level dynamics and energy security capacity of the country makes it possible to distinguish three types of it, in particular: 1) sustainable security; 2) unsustainable security; 3) critical danger. If the actual level of energy security and its capacity have a positive dynamic, then it is logical to consider such condition as a state of “sustainable security”, because the opportunities to ensure its actual functioning and future development increase (Lee, 2013). The leading trends and strategic factors of energy development, as well as potential opportunities for enhancing energy security capacity of countries are shown in Table 6.

Table 6. World leading trends in energy development and opportunities for enhancing energy security capacity of countries

World energy development trends	Description of world trends	Key issue areas for consideration in order to facilitate energy development of a country
Growth of energy consumption	In spite of tough energy conservation policies and increasing level of energy efficiency, the steady growth of energy consumption is expected. The development of world energy industry, ensuring effective global energy security will require investment money estimated for the period up to 2030 at more than 1 trillion US dollars annually.	The energy situation in some countries has a negative tendency relating to high energy intensity of the economy (low usage efficiency, excessive consumption, growth of imports etc.). Large investments are needed to solve the existing problems.
Energy consumption growth will be led by countries non-members of OECD	The growth will be offset by reducing the level of energy consumption by developed countries. As a result, growth of energy consumption per capita at the world level will remain practically unchanged.	Energy consumption is expected to increase, including and per capita. Appropriate measures should be taken at the level of a country, separate companies and households to reduce this rate.
Energy consumption structure does not undergo substantive changes	Oil, natural gas and coal will continue to dominate, partially moving over in favour of renewable energy resources. Provision of constant access to reliable energy sources will require more investment each year. Global trade in energy resources (oil, gas) is expected to increase.	The demand to import main energy sources is essential for the energy sector. There is a need to diversify energy resources and their suppliers in order to optimize energy security of the country.
Development of technologies, which provide capturing and storing carbon dioxide in suitable geological formations	It is expected that, industrial technologies for capturing and storing carbon dioxide (emitted at power plants, large industrial facilities, etc.) in geological formations will be widely developed after 2023.	Significant progress is expected for combined-cycle power plants (with intracircle gasification, complete removal of combustion products). In the heat supply infrastructure, the role of heat pumps is expected to increase considerably.
Growing significance of the electric-power industry	The value of the electric-power industry in the structure of world energy consumption is projected to increase. By 2030, global electricity production is expected to rise to 60% (compared to 2010) and reach the rate 30,000 billion kWh.	Production capacity should be driven by intention not only to meet the level of own energy needs, but also the economic needs of regional groups.
Enhancement of integration processes in the world electrical industry	Development of integration processes in the electric power industry is expected, as well as further integration of national energy systems into transnational energy associations for closer cooperation. This will facilitate the optimization of their activities, strengthening security of energy supply, etc.	Energy policies and development strategies of the country should keep track of this trend and take an active part in the integration process (particularly into energy systems of another countries, groups)
Development of innovative technologies in the energy industry	Successful solution of all the world energy problems can be achieved due to innovative energy technologies. This relates to the problems of constantly rising energy demand in the world, the improvement of energy supply security, environment, climatic conditions, etc.	In the context of high energy consumption of the economy, moral and material aging of key assets, this trend enforces developing innovations in energy sector, since otherwise the country risks losing competitiveness in this field completely and irrevocably.

Thus, the type of energy security for a particular country can be determined on the basis of components shown in Table 6 and therefore be specified as: actual, tactical and strategic energy security (high energy security capacity). If the level of energy security capacity is sufficient to ensure strategic security, then tactical and actual energy security can be achieved. However, if the level of energy security is low, then only actual energy security and development can be provided situationally in the short term. The smallest negative impacts may likely halt the sustainable development of the country, and in the worst case, lead to crisis events and gradual deterioration of the international competitiveness.

5. Discussion

The harmonious economic growth of a country is impossible without energy supply, which implies designing a complementary economic policy in the field of energy. The development of scientific, methodological and applied provisions concerning the economic policy of energy sector in the context of European integration. The system of energy balances will gradually progress. It should comprise additional features, such as complemen-

tarity by the level of renewable energy use and complementarity by the level of energy security and innovation, in order to identify the level of renewable energy use by energy market consumers and to further stimulate the harmonious development of renewable energy consumption by producers and consumers. It enables the consumers of energy products to identify the level of renewable energy use, to stimulate the harmonious development of renewable energy consumption by producers and consumers of energy resources.

The modern energy industry is intensively moving beyond national borders. Experience received by the leading European countries in this field should be a fundamental basis for the development of the legal regulation of energy relations in the world, which are strongly influenced by the various interests of international legal entities in the field of energy security and sustainable development.

Conclusions

One completed a substantive review and thereby defined the leading trends in the world energy market and generation of energy resources. One specified current peculiarities of energy security formation under the influence of national policies of countries-consumers and energy-producing countries. The systemic criteria for the assessment of country's energy security were substantiated. The authors provided an advanced system of risk identification as a continuous process, since in both environments of energy market, external and internal, permanent changes take place, and they can therefore lead to new risks or modification of the previously identified ones. Identified risk should be treated like controlled parameter of the project that can and must be a subject to impact in order to reduce adverse effects (threats) and maximize the benefits. The pattern of hierarchical risk structure of the energy market entity was introduced. One identified the main types of risk, qualitative estimates of the likelihood of their occurrence and impact levels (low, medium, high). Positioning risks within the field of «probability/impact» matrix allows user to prioritize them by two criteria.

The matrix for the assessment of energy security risks was introduced. The policy of energy market relations should be designed not only upon the results of risk identification, assessment and risk management strategy, but also upon the plan of risk responses and control (monitoring) methods.

The purpose of responding to risks is taking the necessary measures to reduce the level of potential threats, provide rational use of possibilities, as well as to lower the costs of certain risk events.

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