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APPLIED SECURITY AND ANALYTICS

UDC 004

Glushchenko V.M., Pronkin N.N. Principles for assessing potential and prevented damage to the information security of a megapolis

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Abstract. *The article considers the principles of assessing the size of potential and prevented damage to the information security of the Moscow metropolis on the basis of a system analysis.*
Keywords: *Moscow megapolis, information security.*

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To ensure the vital interests of the megalopolis in strategic management, it is necessary to proceed from the principles of the necessary reliability of protecting the vital interests of the individual and society, as well as the information security of the megalopolis, a balanced composition of forces and means of protection, the adequacy of countering information threats.

As indicators of the reliability of protecting the vital interests of the individual, society and information security of a megalopolis, we can use the value of the level of integral prevented damage in the socio-economic sphere.

The specific weight of the integral prevented damage in the political, economic, environmental, information and other areas of the socio-economic sphere of the metropolis will be different.

It is advisable to assess the reliability of protecting the vital interests of the individual, society and information security of the megalopolis by the criterion-the probability of protection. Depending on the capabilities of representative and executive authorities in various areas of the life of the metropolis, factors and conditions of information threats, as practice shows, it is advisable to introduce levels of the criterion of reliability of protective measures, for example, low (probability – 0.3), medium (probability – 0.5–0.6), high (probability – 0.8–0.9).

One of the leading principles for determining potential and prevented damage is the principle of reliability, which consists in establishing by the method of expert assessments the significance of damage to information security in the socio-economic sphere from the impact of information threats, based on the balance of vital interests of the individual, society and the metropolis.

The main criterion indicator in the problem under consideration is the amount of potential (prevented) damage to the information security of a megalopolis in the socio-economic sphere due to the implementation of the impact against information threats.

The assessment of direct and indirect damage, as well as the positive and negative consequences of measures that ensure prevented damage, is extremely difficult, mainly because of their manifestation in the most diverse, often difficult to compare, spheres of activity of the metropolis.

To determine the integral potential and prevented damage from the impact of a set of threats in the socio-economic sphere, it is necessary to bring a set of partial estimates into a comparable form.

At the same time, taking into account the specific difficulties associated with the inability in most cases to express the damage caused to the security of a megalopolis in a number of areas in the form of a direct cost estimate, it seems appropriate to use the so-called "relative importance" scale. The methodological basis for this is the method of expert assessments, which is rationally combined with the use of methods of objective quantitative assessment of damage in the form of value. At the same time, the assessment of possible damage is measured by appropriate qualitative, and in some cases quantitative indicators (for example, in the form of material damage), obtained by calculation or expert means.

The development of a methodology for determining the size of potential damage to the information security of a megalopolis can be used to assess the prevented damage in the socio-economic sphere of a megalopolis. At the same time, the reduction of the influence of subjectivity is achieved by shifting the emphasis from a direct assessment of the degree of damage to an expert assessment of the influencing objective factors, the assessment of which can be made with fewer errors with subsequent processing of the results by special mathematical methods.

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BIOTECHNOLOGY

UDC 60

Verevkina M.N. Biotechnological conditions of cultivation growth stimulant

Биотехнологические условия выращивания стимулятора роста

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Abstract. *The best temperature for the growth and reproduction of Kombucha is 30°C. The biomass of the tea mushroom increases in the nutrient medium with the use of 10-15 mg/ml and 5 –10 mg / ml of sugar to a maximum of 18 days of cultivation. In cultivation there is a decrease in the pH of the culture liquid from 5.3 – 6.0 to 2.43-2.71 due to the accumulation of lactic, acetic and other acids. In experiments in vitro proved the bacteriostatic effect of the products of the Association of microorganisms of the fungus on E. coli, S. dublin, S. typhimurium and the spontaneous microflora of saprophytes.*

Keywords. *Stimulator of growth, the cultivation of tea fungus culture liquid*

Аннотация. *Наилучшей температурой для роста и размножения чайного гриба является температура 30°С. Биомасса чайного гриба увеличивается в питательной среде с применением 10–15 мг/мл и 5 – 10 мг/мл сахара максимально к 18 суткам культивирования. В процессе культивирования происходит снижение значения pH культуральной жидкости с 5,3 – 6,0 до 2,43 – 2,71 за счет накопления молочной, уксусной и других кислот. В опытах in vitro доказано бактериостатическое действие продуктов метаболизма ассоциации микроорганизмов чайного гриба на E. coli, S. dublin, S. typhimurium и спонтанную сапрофитную микрофлору.*

Ключевые слова. *Стимулятор роста, культивирование, чайный гриб, культуральная жидкость*

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Многие люди в домашних условиях выращивают, так называемый чайный гриб. Культуральная жидкость этого гриба представляет собой приятный тонизирующий напиток, который обладает профилактическим и даже лечебным действием при желудочно-кишечных заболеваниях, ангинах, головных болях, сердечных неврозах, бессоннице, гипертонии, простудах и т. д. Такой напиток, особенно на меде, считают полезным для детей. Его рекомендуют вместо газированной воды, кваса, ситро. Доказано, что чайный гриб представляет собой сложный симбиоз дрожжевых грибов с уксусно-кислыми бактериями и некоторыми другими микроорганизмами [2, 41 с].

В первые дни культивирования рост гриба проявляется в виде нежной пленки. Вначале наблюдается процесс ферментации дрожжевыми клетками сахара из питательной среды. При этом происходит образование этилового спирта и углекислого газа. Из-за обильного газообразования тело гриба, в виде постоянно утолщающейся пленки, удерживается на поверхности жидкости в течение всего срока культивирования. Затем бактерии превращают спирт в уксусную и другие органические кислоты (молочную, щавелевую, лимонную, глюконовую и другие). Считают, что микроорганизмы-симбиониты чайного гриба кроме указанных веществ образуют некоторые витамины (аскорбиновую, никотиновую, пантотеновую кислоты, рибофлавин). В культуральной жидкости чайного гриба содержатся еще такие целебные вещества, как кофеин и катехины. В настоящее время в арсенале лабораторной службы отсутствуют отечественные питательные среды для культивирования, выделения и идентификации патогенных микроорганизмов, в том числе листерий [1, 32 с.].

Задачи и методы исследований. В связи с отсутствием стандартных подходов к выращиванию чайного гриба и определения оптимальных доз продуктов его жизнедеятельности для задержки роста и размножения патогенных, условно патогенных и сапрофитных микроорганизмов мы задались целью разработать технологию выращивания гриба в лабораторных условиях. Для реализации этой цели мы поставили следующие задачи:

1. Определить оптимальные дозы чая и сахара для успешного выращивания ассоциации микроорганизмов чайного гриба.
2. Установить температурные режимы для успешного выращивания гриба.
3. Установить сохранение жизнеспособности гриба при различных условиях его хранения.

Для решения этих задач мы пользовались общепринятыми микробиологическими методами исследований. Выращивание чайного гриба проводили при температурах 20, 30, 37 градусов по Цельсию. В результате исследований установлено, что наилучшей температурой роста и размножения чайного гриба является температура 30°С, что свойственно большинству представителей типа Fungi. Изучение динамики роста чайного гриба мы проводили по накоплению его биологической массы, что определялось взвешиванием тела гриба на торзионных весах. Одновременно при этом определяли влияние на увеличение массы тела гриба различных доз чая и сахара. Опыты проводились в пробирках, засев культуральной жидкости происходил из расчета 1:10. Пробы для взвешивания тела гриба брали через три и четыре дня в течение четырех недель. Результаты исследований представлены в табл. 1.

Таблица 1

Биомасса чайного гриба в среде с различным содержанием сахара

Месяц	Январь						Февраль				
Число	13	17	20	23	27	31	3	7	10	14	17
мг/мл	Вес, мг										
50	—	50	214	268	688	1214	1250	1350	1290	1102	1009
100	—	20	100	522	634	1076	1100	1382	1301	1100	989
150	—	20	100	208	606	1046	1081	890	1180	1252	1159
200	—	—	50	172	306	686	916	1152	1204	1336	1306
250	—	—	50	208	220	496	718	1032	1028	1016	981

Данные таблицы свидетельствуют, что биомасса чайного гриба в среде с различным содержанием сахара (50, 100, 150, 200, 250 мг/мл) в первые 3 суток роста гриба интенсивно увеличивалась в среде, содержащей 100 мг/мл сахара. В последующие четверо суток рост гриба в среде с содержанием сахара 50 мг/мл выравнивался с таковым при 100 мг/мл содержания сахара и в последующем даже превосходил его в промежутке от начала второй и до конца третьей недели. При содержании в среде сахара 150, 200, 250 мг/мл накопление биомассы было ниже, чем при его концентрации с 50 – 100 мг/мл, т. е. высокие концентрации сахара в чайном экстракте действуют ингибирующе на прирост биомассы чайного гриба. Уменьшение биомассы чайного гриба наступает в среде без подкормки в емкостях с содержанием 50 – 100 мг/мл сахара с 18 суток его роста. Очевидно, этими сроками необходимо ограничивать технологию производства культуральной жидкости чайного гриба с последующим использованием его как пищевого напитка и как продукта, подавляющего жизнедеятельность различных микроорганизмов семейства энтеробактерий.

Одновременно в эти же сроки мы определяли значение реакции среды (pH) при культивировании чайного гриба с различным содержанием сахара. Результаты представлены в табл. 2.

Таблица 2

Значение реакции среды pH с различным содержанием сахара

Месяц	Январь						Февраль				
Число	13	17	20	23	27	31	3	7	10	14	17
мг/мл											
50	5,3	4,04	4,12	4,0	3,82	3,85	3,83	3,86	2,79	2,78	2,69
100	5,6	4,13	3,91	3,87	3,86	3,86	3,81	3,75	2,6	2,62	2,48
150	5,6	4,15	4,15	4,2	3,92	3,88	3,84	3,84	2,67	2,65	2,71
200	6,0	4,1	3,93	3,86	3,8	3,8	3,65	3,65	2,55	2,5	2,43
250	5,9	4,13	3,88	3,94	3,77	3,71	3,68	3,66	2,48	2,43	2,48

Приведенные данные свидетельствуют, что в процессе роста чайного гриба pH закономерно снижается от 5,3 – 6,0 до значения 2,43 – 2,71. Снижение значения pH в основном происходит за счет наличия в культуральной жидкости молочной, уксусной, частично масляной кислот, которые, по нашему мнению, придают напитку приятный вкус и ароматичность.

В ходе исследований мы использовали различные дозы чая. Чай заваривался кипятком и настаивался в течение 30 минут. Биомасса чайного гриба в среде с различным содержанием чая (5, 10, 15, 20 мг/мл) увеличивалась при содержании в среде 10 и 15 мг/мл чая. В опытах in vitro нами установлено бактериостатическое действие продуктов метаболизма ассоциации микроорганизмов чайного гриба на E. coli, S. dublin, S. typhimurium и спонтанную сарофитную микрофлору. Это дает основание считать, что культуральную жидкость чайного гриба можно рекомендовать для профилактики заболеваний кишечными инфекциями.

Выводы. Для хорошего роста чайного гриба в питательной среде оптимальным является содержание чая и сахара соответственно 10 – 15 мг/мл и 50 – 100 мг/мл. Снижение значения pH с 5,3 – 6,0 до 2,43 – 2,71 происходит за счет накопления молочной, уксусной, частично масляной кислот. Эфиры этих органических кислот придают напитку приятную ароматичность и вкус. В опытах in vitro доказано бактериостатическое действие культуральной жидкости чайного гриба на некоторых энтеробактерий и сапрофитную микрофлору.

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ECONOMY, ORGANIZATION AND MANAGEMENT OF ENTERPRISES, INDUSTRIES, COMPLEXES

UDC 330.45; 338.2

Gurskaya Y.M., Elizarova M. I., Slavyanov A.S. Matrix tools for the formation of a corporation'sinvestment portfolio in conditions of financial instability

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Abstract. *The paper analyzes the existing methods of evaluating the effectiveness of investment projects, which take into account mainly the financial result. In an unstable external environment, the influence of external factors can significantly affect the effectiveness of the project, which are usually not taken into account. An industrial corporation can assemble a portfolio of projects that will meet its goals with maximum results. At the same time, several scenarios should be taken into account, each of which corresponds to a certain result. Taking into account the probability of occurrence of each event, a portfolio of investment projects is formed. To solve this problem, it is proposed to use a matrix toolkit developed on the basis of the methodology of game theory. The paper proposes an approach based on the matrix method of forming a portfolio of projects that ensures uniform and sustainable development of the corporation.*

Keywords: *investment project, economic efficiency, payment matrix, project portfolio, matrix*

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Introduction

The existing methods of selecting investment projects are mainly focused on achieving a financial result, when the project that will give the maximum economic effect is selected. at the same time, the public, social, budgetary and other effects of the project are not always taken into account. Thus, the introduction of automatic lines, robots, processing centers and other advanced equipment allows to multiply the output of products, but their use leads to the release of labor, which will affect the unemployment rate, a decrease in purchasing power, and an increase in social tension is possible. Due to these negative effects, it is necessary to implement another project that would create jobs in the region. It can be argued that it is almost impossible to find such a project that would give positive effects in all areas, and therefore, the problem of selecting projects in such a portfolio that would ensure the uniform and sustainable development of the economic system becomes urgent.

Materials and Methods

When making a decision, the investor uses tools based on discounting cash flows, which allow you to correctly compare several projects, the volume of investments and the return of funds in which does not coincide in time. Based on the obtained value of the net present value of the project (NPV), the derivatives NPV are analyzed - the internal rate of return of the project (IRR); the profitability index - (Profitability Index); the payback period of the project, etc. [1, 7, 11] These methods are widely used in industrialized countries with market economies, due to their ease of use for evaluating economic efficiency and selecting commercial projects, where the financial result is the determining indicator. Using these tools in countries with a developing economic system characterized by its instability and high risks, these methods led to unexpected conclusions. Calculations based on these methods showed that it is unprofitable to conduct research and development on the basis of domestic research organizations, it is much more efficient to get technological licenses or finished products abroad than to go through the entire innovation cycle independently [2, 12]. As a result, in the early 90s, the development of its own software was stopped in Russia and the country completely switched to foreign software, projects in the aviation, machine-tool industry, instrument-making and other knowledge-intensive economic activities were frozen. Local markets of high-tech products and services in a short time came under the influence of foreign corporations, and the economic sanctions that followed, due to the complication of the international situation, damaged the innovative development of the country [13].

The paper proposes, on the basis of mathematical modeling methods, to develop a mechanism for selecting projects in the portfolio that ensures the achievement of not only the commercial goals of the investor, but also the solution of social, environmental and other tasks of society.

Результат

The selection of projects that will determine the development of the corporation for the next decades should be carried out not only by evaluating the financial result, but also by social significance [9].

The economic state of the corporation at the current time can be described by a certain set of indicators, which may include indicators of economic, innovative and social development, as well as the level of security, sustainability, and others. It is proposed to analyze the development of the corporation in dynamics in Table 1, where we will enter the current and planned state of the system.

Tabl. 1

System State Matrix

System indicators	The current state of the system (A)	Planned state of the system (B)	Planned change (C) $Y^c = Y^b - Y^a$
Y_1	$Y^a{}_1$	$Y^b{}_1$	$Y^c{}_1$
Y_2	$Y^a{}_2$	$Y^b{}_2$	$Y^c{}_2$
….	….	….	….
Y_i	$Y^a{}_i$	$Y^b{}_i$	$Y^c{}_i$
….	….	….	….
Y_{m-1}	$Y^a{}_{m-1}$	$Y^b{}_{m-1}$	$Y^c{}_{m-1}$
Y_m	$Y^a{}_m$	$Y^b{}_m$	$Y^c{}_m$
F (resource)	-	-	F

Где Y_i - System indicators, F – Resource.

In the matrix form, the economic state of a corporation can be represented in the form of three column vectors:

$C = B - A$,

where a is the column vector of the current state of the system, B is a column vector of the planned state of the system and the column vector of the change (S).

It should be noted that the matrix method was used to estimate the economic efficiency of production and economic activities of market entities [8], however, focused on cost indicators such as income, value added commodity products etc., while indicators of social effect attention has not been paid.

The planned state of the system should be determined based on the goals of its strategic development at the current stage [4]. The change in the state of the system is achieved by the implementation of a certain set of projects and programs, which includes those activities that will have the most positive impact on the result in the conditions of budget constraints [6].

Each project has a diverse impact on the system status indicators and requires a certain amount of resources. Thus, the growth of total output (a positive factor) due to the use of foreign technologies can negatively affect the economic security of the system and its sovereignty or lead to environmental problems (a negative factor). An increase in labor productivity (a positive factor) can lead to an increase in the unemployment rate and a decrease in disposable personal income (a negative factor) , etc. It may turn out that some indicators will be achieved by reducing others, and this may slow down the development of the system. The task will be to form such a composition of the project portfolio:

$$X = \sum_{j=1}^{n} Xi \, , \tag{1}$$

which could satisfy the condition:

$$C \leq X \tag{2}$$

under restrictions:

$$F \leq \sum_{j=1}^{n} Fj \, , \tag{3}$$

where F – the total budget for financing the development of the system, F_j - budget j-project, X - vector column of the project portfolio, X_i – vector column j-project of portfolio, n – number of project's . From all the projects submitted for consideration, it is possible to collect a certain set of portfolios that will meet the conditions (2) and (3).

$X_k \in X$

$$X = \{1, 2, 3, \ldots k, \ldots s\text{-}1, s\} \tag{4}$$

Each project is characterized by its own final results and the level of their achievement:

$Y_i \in Y$

$$Y = \{1, 2, 3, \ldots i, \ldots m\text{-}1, m\} \tag{5}$$

To achieve these goals, it is necessary to choose from a set of X such a portfolio of projects that would contribute to the maximum possible result on the one hand, and on the other, would be resistant to the most unfavorable environmental conditions [3, 5]. The external environment (E) can be in various states-from threatening to favorable [10] and this will inevitably affect the indicators (Y_i) project of programm's:

$$E_q \in E$$

$$E = \{1, 2, 3, \ldots q, \ldots q-1, Q\} \quad (6)$$

After calculating the project indicators for all possible states of the external environment, we will enter the results obtained into the payment matrix of the game (Table 2).

Table 2

Project indicators in various states of the external environment

Project indicators	The state of the external environment					Mathematical expectation of the result indicator
	E_1	…	E_q	…	E_Q	
	Probability of the state of the external environment					
	P_1	…	P_q	…	P_Q	
Y_{1-j}	Y_{1-j} (E_1)	…	Y_{1-j} (E_q)	…	Y_{1-j} (E_Q)	$Z_{1-j} = \sum_{q=1}^{Q} Y1j(Eq) \times Pq$
…	…	…	…	…	…	…
Y_{i-j}	Y_{i-j} (E_1)	…	Y_{i-j} (E_q)	…	Y_{i-j} (E_Q)	$Z_{i-j} = \sum_{q=1}^{Q} Yij(Eq) \times Pq$
…	…	…	…	…	…	…
Y_{m-j}	Y_{m-j} (E_1)	…	Y_{m-j} (E_q)	…	Y_{m-j} (E_Q)	$Z_{m-j} = \sum_{q=1}^{Q} Ymj(Eq) \times Pq$

Yi-j – i –indicator j -project; Y_{i-j} (E_q) – indicator state of the external environment (E_q); Z_{i-j} – Mathematical expectation of the result indicator. We will represent the project portfolio in the form of a matrix Z, which will be the sum of the matrices of several projects Z_j.

In conditions of uncertainty, the portfolio is formed based on the condition:

$$C \leq Z, \quad (6)$$

where Z is the matrix of the project portfolio, calculated under conditions of uncertainty, under previously introduced budget constraints (3).

Conclusions and conclusion

This approach can be used to form a portfolio of projects that ensure the achievement of the goals of the corporation's development program and any other economic system, both in conditions of relative stability and in conditions of uncertainty. The proposed approaches to solving the problem of balanced and sustainable development of the economic system can be developed in models based on game theory.

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SUSTAINABILITY

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Khlopov O.A. Energy Transition and Environmental Crisis

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Abstract. *The article examines the key aspect of energy transition that deals with radical abandonment of hydrocarbons in favor of "clean" energy on the basis of technological breakthroughs in energy efficiency and decarbonization with the idea that the satisfaction of humanity's needs should be carried out without damage to the ecosystem. The author provides an analysis of key elements of global energy transition, energy policy of US and China as the main consumer of hydrocarbon resources in the worlds that have their own environmental plans in order to solve national environmental problems, and also emphasizes the need to implement a global strategy with various to combat climate change.*
Keywords*: energy transition, sustainable development, renewable energy security, climate change, USA, China.*

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Introduction

Today world economy is in a state of change: the development strategies of countries and global markets are being transformed, there is a transition to a new system of international economic relations. The shift in economic growth towards Asia implies a redistribution of energy transport flows towards the most attractive markets. The role of Asian states has changed significantly both in the world economy and in the world energy sector, which is due to increased competition for markets, technologies, and energy resources. As for the post-industrial countries, where economic growth rates are lower, they are trying not to lose their leading positions.

New we have the fourth energy transition in world history, but instead of one technological revolution, as was the case with steam, there is now a whole range of technological breakthroughs in energy efficiency and decarbonization. The first energy transition is associated with the transition from firewood to coal. The second, in turn, replaced coal-fired power generation with oil. And finally, the third energy transition has partially replaced liquid hydrocarbons with natural gas. Of course, this did not happen everywhere. But the main thing in this fourth energy transition is the idea that the satisfaction of humanity's needs should be carried out without damage to the ecosystem.

The benefits of energy transition are talked about solely in terms of combating global warming and reducing greenhouse emissions. However, the negative technological, social, geopolitical, investment and even environmental consequences of the energy transition are currently far from being fully assessed and can neutralize its positive components.

The energy transition - the gradual abandonment of hydrocarbons in favor of "clean" energy - has already been recognized by even the most inveterate skeptics. Companies and states are racing to make plans to reduce the production and consumption of traditional energy carriers, increasing investments in solar and wind generation, hydrogen technologies, etc.

In the 21st century, the environmental agenda is coming to the center of global economy. Today, the impact of environmental problems on the world economy is especially noticeable. The Paris Agreement on Climate Change adopted in 2015 sets long-term goals to guide all nations: substantially reduce global greenhouse gas emissions to limit the global temperature increase in this century to 2 degrees Celsius while pursuing efforts to limit the increase even further to 1.5 degrees; review countries' commitments every five years; provide financing to developing countries to mitigate climate change, strengthen resilience and enhance abilities to adapt to climate impacts [1].

At the same time, we have not yet reached a general agreement on environmental protection. Industry has become a driver of economic growth in many countries, which provide high rates of economic growth because of large consumption of energy resources, most of traditional types. With respect to post-industrial countries, a policy of increasing energy efficiency and energy saving is being pursued, with the help of which the growth rates of industrial production remain more moderate, and the focus of consumption is shifted to renewable energy sources.

The Key Elements of Global Energy Transition

The widespread onset of the “green” agenda, it already considered its coverage and impact on an increasingly growing number of spheres of human activity a fait accompli, and the process itself has become irreversible.

Some economists and political scientists have already (and not without reason) hastened to name the “green” agenda as one of the major drivers of the forthcoming Fourth Industrial Revolution. According to this agenda low-carbon energy and industrial production should by 2050-2060 almost completely displace and replace traditional fossil energy sources and carbon-intensive processes and technologies in order to meet the requirements of the 2015 Paris Climate Agreement [2]. A number of “green” technologies, especially in using solar and wind energy Received an additional powerful impetus/

The fourth industrial revolution implies an increase in the share of renewable energy sources and, a decrease in the consumption of traditional energy sources in the world energy balance, which is fully consistent with the theory of the Global Energy Transition.

The term “energy transition” was proposed by V. Smil, one of the most famous economists in the world from the University of Manitoba in Canada, and is used to describe a change in the structure of primary energy consumption and a gradual transition from the existing energy supply scheme to a new state of the energy system [3]. This transformation implies four elements, energy efficiency and the “three Ds”: *decarbonization, decentralization and digitalization*. The transition to carbon-free energy resources, the development of distributed energy and the use of digital technologies are the main directions of changes in the global energy markets. Vaclav Smil considers the unresolved problems of wind and solar generation, including ensuring continuity or even the very possibility of their use in different parts of the planet, as a signal, that the energy transition will not be rapid and the transition from coal and oil to wind and solar energy is not a question of several decades, but a question of generations.

The energy transition that is taking place today is the fourth shift in the structural transformation of the global energy sector. The essence of the energy transition is a reorientation to the widespread use of renewable energy sources that will supplant fossil fuels [4].

The driver of the fourth transition is not only the attractiveness of new energy sources, but also decarbonization and the fight against global climate change. Objectively, energy transition trends affect the modern politics of many states. In particular, low-carbon energy dictates the need to minimize the human impact on the climate, which implies a decrease in CO2 emissions into the atmosphere, an increase in the energy efficiency of production, which can be realized only through completely new technological solutions and innovations that can change the energy sector. Within the framework of energy security, states set the goal of reducing dependence on imports of hydrocarbons and increasing the supply of their own efficient low-carbon sources.

The development of new technological solutions in the energy sector has varied results. First, energy sources are becoming more affordable, which makes the supply diversified. Second, new conditions for the use and competition of energy resources are being developed. Third, thanks to technological solutions, the nature of consumption becomes more energy efficient, which leads to a decrease in demand for energy resources. Fourth, the decentralization of energy is developing, as new energy supply mechanisms are being created. Fifth, inter-fuel competition develops, which reduces the "exclusivity" of one type of fuel for a particular sector [5].

If we consider the transport sector, which is dominated by petroleum products, the process of transition to electricity is rapidly underway. The use of electric vehicles is growing against the background of a radical reduction in their cost, and the use of fuel cell vehicles, which are based on hydrogen or hydrogen-containing fuels, is increasing. At the same time, many countries directly support the increase in using electric vehicles with direct government subsidies and tax incentives. The growth in the number of electric vehicles will limit the growth in demand for oil and lead to a decrease in its prices. Thus, technological progress is gradually displacing oil products from the transport sector, replacing them with other diverse sources.

In industry, due to the long-term trend of increasing the energy efficiency of industrial equipment, production has become less energy intensive, which has reduced the share of this sector in global energy consumption. We use electricity more and more - the most versatile source, which is increasingly used in industry and reduces dependence on a certain energy resource.

Unlike the oil market, for the gas market, the sped up development of energy technologies, combined with socio-economic trends, does not lead to a peak in consumption and a decrease in demand, but the operating conditions for the gas market will change. During the forecast period, almost 85% of the world's net gas exports will come from just a dozen countries, which, besides Russia, will include Qatar, Australia and the United States. Regarding African countries, they will also increase gas exports: Nigeria, Mozambique, Tanzania.

In terms of overall import trends, there has been a shift in trade flows to the Asia-Pacific region, namely to South and Southeast Asia. Despite the constantly growing number of natural gas importing countries, about 70% of gas volumes in 2040 will be accounted for by a dozen countries, including the 5 largest gas importers - China, India, Japan, Germany and South Korea.

European countries will continue to increase their gas imports as their own production declines. However, the growth rate of imports will decline as the peak in gas demand in this region passes.

The increase in the number of LNG consumers and the expansion of the territory of its supply, especially to markets remote from the centers of gas production, will contribute to the growth of the importance of LNG in the global gas trade.

Considering the solid fuel market, currently about 38% of all electricity generated in the world is generated from coal. Currently, the main leaders in the world production of traded coal are China (46.4%), USA (9.8%), India (7.8%), Indonesia (7.2%), Australia (7.9%), South Africa, Colombia and Russia (5.5%).

Despite the conflicting consequences of coal consumption, this energy resource remains a priority for the economic growth of many countries, as it is one of the cheapest and most accessible sources of energy. Nevertheless, under the influence of energy transition instruments, which include the development of renewable energy sources, storage of electricity, distributed energy resources, etc., countries with developed economies and technological potential are setting the task of gradually reducing the share of coal in the energy balance, pursuing the goals of the modern climate agenda and reducing harmful air emissions.

Today, the development of the coal industry is greatly influenced by environmental restrictions. Their tightening leads to an increase in costs in coal-fired generation through introducing measures to suppress harmful emissions with environmental payments. The reduction in the cost of alternative sources and introducing “carbon” payments reduce the profitability of coal generation. Moreover, an increase in the share of renewable energy sources creates technical challenges, since the coal industry must also become technically advanced and maneuverable. As a result, “clean coal” technologies are now being developed: modern coal plants have very low emissions. If we consider them at the level of gas, then they are very effective.

Thus, the trends in the development of world energy are due to the ongoing energy transition, which also sets the directions for the energy policy of modern states. The widespread use of renewable energy sources and the decline in the share of fossil fuels are what is happening in the global energy market today [6]. Therefore, states must adjust their development strategies to global changes in order to implement national energy interests and strengthen energy security.

The Essence of Energy Security and Environmental Plans of USA and China

Currently, the image of the world energy is shaped by political factors: economic and political sanctions, local conflicts and wars, coups d'etat. They determine the state of the regional and global energy markets. Energy is an integral part of politics, often its motive and goal. The growing link between political ambition and the need for energy makes it increasingly difficult to ensure the uninterrupted supply of fuel and energy [7].

We should note that the growing importance of energy resources, combined with modern trends in energy development, shows the interdependence of the foreign policy of world players and energy security. States enter a competitive struggle, where the major component is rivalry for control over territories rich in natural resources, sales markets, transit infrastructure, etc. them and the preservation of energy security. At the same time, the limited availability of certain energy resources, infrastructure and technologies comes to the fore, which creates threats to the stable provision of the economy and state security. The energy industry has a significant impact on the political activities of states [8].

First, the first factor is the rapid and highly uneven growth in energy demand across countries and regions of the world. Today, China is the world's largest consumer of electricity, followed by the United States, India and Russia.

Second, energy resources, in particular oil and gas, are unevenly distributed around the world, which leads to a decrease in energy independence and a corresponding foreign policy course.

Third, if a country depends on external supplies, then the process of ensuring their continuity becomes an object of state security, which determines the political motivations of the leading powers.

Fourth, in the XXI century energy has become one of the most technology-rich and innovative areas. Today, new energy technologies are a strategically valuable resource that allows not only expanding the resource base of the energy sector, but also increases its energy efficiency. Therefore, today there is global competition in the energy markets, where the “technology race” has become the goal and instrument of foreign policy of many states.

In order to ensure energy security, any state seeks to find a balance in the “energy triangle”, which is also called the “energy trilemma”. To build an efficient and safe energy sector, it is important to maintain a balance between economic growth, environmental sustainability, energy security - the three components of each corner of the “triangle”. The essence of the “energy trilemma” is the need to ensure the *availability* of energy in sufficient quantities at *affordable prices* and without harming the *environment.*

Energy is increasingly becoming one of the key elements of geopolitics, and political interests influence trends in the energy industry. The energy security of states directly depends not only on the situation in the world energy markets but also on the results of climate change and the solution of environmental problems.

Floods, droughts, hurricanes are already causing multibillion-dollar damage to the economies of countries, but if climate changes continue at the same pace, natural disasters will become more frequent and even more destructive. A warmer climate, as well as some other external factors, will lead to changes in the demand for energy resources. There will be a shift in priorities from oil and coal to gas and renewable energy, as households and other elements of urban infrastructure will have to strengthen their air conditioning and cooling systems. If global warming continues at the same rate, it will attract significant sea level rise, as well as more destructive and powerful hurricanes on the Atlantic and Mexican coasts.

For example, drought in certain areas of the United States will cause changes in the structure of the energy sector. The drought will limit the use of hydroelectric power plants, and as a result will lead to a crisis in the electricity sector, since the share of hydropower accounts for 6 to 10% of all energy produced in the country. Sectors of the economy, such as tourism, agriculture, real estate and construction, and the insurance market for adverse weather conditions are highly affected by natural disasters and changes. Various measures and instruments of environmental policy should compensate for the negative impact that a polluted environment has on economic growth [9].

Climate change, as well as air pollution, impact the quality of life and health of people. As the air temperature rises, so will the concentration of ozone in the atmosphere. The increased amount of impurities of harmful substances in the air is the reason for the increase in the number of people suffering from various congenital and gained respiratory diseases, such as asthma, lung cancer and others. In addition, a significant excess of ozone concentrations in the atmosphere causes premature death in adults, as well as an increase in the number of children suffering from asthma since birth.

The report, released in August 2021 in Geneva by the United Nations agency's Intergovernmental Panel on Climate Change, emphasizes that the increase in greenhouse gases in the atmosphere is "clearly caused by human activity." In 2019, the concentration of carbon dioxide was the highest in at least the last 2 million years [10].The debates on geopolitics and the environment have emerged as part of a broader discourse on environmental security. [11].

Today, the United States is the largest source of carbon dioxide emissions into the atmosphere, as of 2016, they reached 6,870 million metric tons. In 2017 D.Trump radical changed environmental policy of the United States. He abolished many environmental standards had been adopted by the B.Obama government [12] and USA pulled out of the Paris Climate Agreement [13].

However, under the Biden administration, the United States returned to the Paris climate agreement and ecology returned to the agenda of national policy. Joe Biden has canceled the Keystone XL pipeline, which is only part of the already operating Keystone pipeline, which started operating in 2010 [14]. Its starting point is in Canada, at the Athabasca tar sands field. The pipeline was supposed to deliver "black gold" from the Canadian province of Alberta to refineries in the US, Texas, on the shores of the Gulf of Mexico, and also suspended the issuance of drilling licenses on federal lands, and also proposed to increase taxes for oil and gas companies.

The most important element of Biden's climate strategy was to connect it to revitalizing the American economy. Decarbonizing the energy system can create a lower-priced and cheaper form of energy. Rather than taxing carbon and raising energy prices, Biden wants to subsidize renewables and lower energy prices.

Previous climate initiatives focused on reducing greenhouse gasses by regulating fossil fuel emissions through a carbon tax, command and control regulation, or through a cap-and-trade system. Biden's policies will work with utilities and other greenhouse gas emitters and help directly fund the transition to renewables. There are emission-reduction targets, but they are coupled with a realistic understanding of the need to help utilities and industry fund the capital costs of the transition.

President Biden directed the federal government to develop a climate change risk mitigation strategy for public and private financial assets in the United States.

The move is part of the Biden administration's long-term program to halve U.S. greenhouse gas emissions by 2030 and move to a zero-emission economy by mid-century, while limiting the damage that climate change causes to all sectors of the economy. The situation is similar in the European Union, Japan, South Korea, Canada, which approved the strategic goal - zero net emissions" by 2050, and China - by 2060.

The energy policy of the China is aimed at solving the following problems: a shortage of its own energy resources, an imbalance in the structure of energy supply and energy consumption, low energy efficiency, an environmental crisis, and the country's growing dependence on imports of oil and gas. At the internal level, emphasis is placed on the modernization of the sectors of production and consumption of energy, increasing energy efficiency and energy saving, which is caused by the need to overcome the environmental challenges that accompany the rapid economic development of the country. Reducing greenhouse gas emissions into the atmosphere, increasing consumption of natural gas and renewable energy sources, ratification of the Paris Climate Agreement - all of this today refers to the energy policy of China. At the external level of China the state faces such challenges in the energy sector as weak diversification of sources of energy imports, irrationality of the energy structure. The 13th five-year plan sets goals to overcome these challenges both at the internal and external levels: the economy-energy-ecology link is decisive and affects not only the development within the country, but also the state's capabilities in the international arena [15].

Conclusion

In accordance with the Address of the President of the Russian Federation to the Federal Assembly in 2021, among the technological priorities of the Russian energy sector, the development of nuclear and hydrogen energy, as well as energy storage, is highlighted, which is largely due to the significant impact of climate and green problems on world energy and politics. These areas presuppose the intensification of international cooperation, which is especially important at the present time, when the world faces an exacerbation of geopolitical confrontation at the global and regional levels.

Thus, the modern world energy is changing under the influence of the development of new technologies, the world is entering the stage of the 4th energy transition, which implies the use of renewable energy sources and a decrease in the consumption of fossil fuels. This transformation creates qualitatively new conditions for the development of energy strategies of states. The low-carbon energy dictates the need to reduce carbon dioxide emissions and increase the energy efficiency of production. Moreover, within the framework of energy security, states set the goal of reducing dependence on imports of hydrocarbons and increasing supplies from their own efficient low-carbon sources.

The ideal option is to develop and implement a global strategy aligned with the national strategies of each country. Today international organizations, including the UN, are gradually moving towards the creation of such a strategy, implementing various environmental initiatives and initiatives to combat climate change. However, it is still difficult to call today's agreements a full-fledged completed strategy - too large-scale task has to be solved and too different starting conditions for many countries. The complexity of the problem requires extensive study, detailed scenario analysis, and the involvement of specialists of various profiles. At the same time, the energy transition offers opportunities for creating long-term competitive advantage.

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