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**Karaieva Nataliia Veniaminivna**

*PhD in Economics, Associate Professor, Associate Professor  
of the Heat and Power Engineering Department,  
National Technical University of Ukraine «Kyiv Polytechnic Institute», Ukraine*

## **GLOBAL ENERGY CONFLICTS AND SUSTAINABLE DEVELOPMENT RISKS CAUSED BY THE CLIMATE CHANGES**

*Article objective is analysis of the threats and risks for sustainable development of the World and Ukraine due to climate change in the context of traditional energy. According to the results of cluster analysis the nature of the conflict between the major players in the global energy market are identified. During the 2000-2011 years the dynamics of changes of the country-leaders in the overall values of environmental and energy indicators for sustainable development of the World were fulfilled. The sources of risks for sustainable development of Ukraine caused by the climate change are defined.*

**Keywords:** *sustainable development, energy conflicts, risks, climate changes, CO<sub>2</sub> emission.*

**Introduction.** Today, one of the major global issues the humanity is facing is an issue to provide a sustainable economic World and national development with the needed fuel and energy resources and, respectively, to provide global and national energy safety. It was the very explosive development of industry and transport in XX century which was provided by hard coal, oil and natural gas that were easily available. However these sources exhaust very fast, their extraction becomes more and more expensive/costly. Energy resources prices are growing all the time. Besides, use of traditional energy resources significantly deteriorates environment in the extraction and consumption sites/locations. Growth of world demand in fuel and energy with resource and environmental constraints of traditional energy sector determines the emergence of the modern world conflicts. Global climate change and resource depletion of oil and other energy factors are socio-economic conflicts exactly.

Today, Ukraine becomes the object of global energy conflict. Besides, energy and environmental problems faced by Ukraine today are the result of long-term neglecting of the laws of development of relationship between a human being and nature, these are lessons of inefficient, irrational, wasteful use of natural energy resources by humans.

**Analysis of recent researches and publications.** Strategic principles and

provisions of the current paradigm of Sustainable Development (SD) is given in the reports (documents) of UNEP (United Nations Environmental Programs (UNEP) [1, 2], OECD (Organization for Economic Co-operation and Development) [3] and European Council [4, 5]. In these reports mentioned that the exhaustion of fossil fuel deposits, deterioration of air and water basins, acid rains and green house effects – within recent years they all became significant risks for SD of civilization. Mechanisms and incentives making energy wastefulness lean should be created and implemented in all spheres of life.

The Ernst & Young's reports presents the results of studies of risks for SD of economic, energy and business [6]. Research by Ernst & Young focused on the development of political's tools to minimize the risks.

Mentioned problems were investigated by many Ukrainian researchers in the field of SD, environmental economics and energy security. During the 2010-2014 years the results of their research more fully presented in authors monographic publications [7-13 and others]. In these publications the basic thematic areas of author's research are:

- the paradigm and environmental policy instruments of SD (Andrjejeva N.M., Veklych O.O., Harichkov S.K., Hlobystov Je. V., Zharova L. V. and others);
- SD of Ukrainian regions (Gerasymchuk Z. V.)
- system's analysis of SD (Zgurovskyj M.Z.);
- conflicts between economic development and environmental quality (Melnik L., Kubatko O.);
- marketing and management of environmental innovations (Illiashenko S.M., Prokopenko O.V.);
- green technologies of SD (Potapenko V.G.)
- the energy threats and risks of SD (Barannik S.O., Lir V.E., Sabadash V.V., Sotnik I.M)
- the sources of risks for SD of Ukraine caused by the climate change (Orlenko S. L., Zhalilo Ja. A.) and etc.

**Previously unsettled problem constituent.** Analysis of the recent research and publications shows that, these results were received for rather sustainable situation in the World and Ukrainian regions, but political and economic crises persuade to indicate principal problems and choose measures according to modern conflict situation.

**Main purpose of the article** is analysis of the environmental and economic threats and risks for SD of the World and Ukraine due to climate change in the context of traditional energy. Also, identify the sources of modern energy conflicts and their impact on the environmental risks of SD.

**Results and discussions.** Global energy threats for SD physical, economic, social and environmental risks are defined, namely [11, 14]:

Physical risks are primarily in the possibility of fossil fuels deposits exhaustion. Besides, a possibility of significant natural disasters and geopolitical crises that may affect the stability of supply is not excluded.

Economic risks are related to the price fluctuations for main fuel and energy resources and the world markets that cause imbalance in the financial and trade spheres and carry significant threats to economic wellbeing.

Social risks are also related to prices instability that can cause a serious dissatisfaction of consumers.

Environmental risks are related to the possibility of accidents at nuclear and thermal power plants, oil spills, gas spills and other accidents at the energy sector companies, as well as with permanent spills of pollutants. Besides, special attention is paid to measures related to global warming prevention.

The growth of energy consumption is the first risk factor for energy conflicts. Table 1 shows that for the period 2000-2011 years consumption of total primary energy supply (TPES) increased by 15.5 % and electricity (Elec. Cons.) by 44.6 %. This growth is explained with the World economic growth rate (68,4 %), World population increase (15,5 %) and the more and more growing role of energy resources in humanity's life.

Table 1  
**Evolution of the major environmental and energy indicators for SD,**  
 (developed by author)

Year	Population (million)	GDP (PPP) <sup>2*</sup>	Energy Prod. (Mtoe)	TPES (Mtoe)	Elec. Cons. (TWh)	Emissions CO <sub>2</sub> (Mt of CO <sub>2</sub> )
2000	6023	41753	10078	10110	14115	23444
2006	6536	57564	11796	11740	17377	28003
2011	6958	70313	13202	13113	20407	31342
% growth	15,5	68,4	31,0	29,7	44,6	33,7

*Note: 1) compiled and calculated according to the World Energy Statistics data [15-17]; 2)\* – indicator GDP PPP at different times has the following dimensions: 2000, 2006 – GDP (PPP)\* (billion 95 US\$), 2011 – GDP PPP (billion 2005 US\$).*

World economic growth is accompanied by a significant increase in energy consumption, aggravation of the struggle for access to hydrocarbons, increased competition in the energy market. Therefore, basic risk factor for SD of the global world and political turmoil is sharp differentiation countries in terms of energy supply and energy consumption. According to the results of cluster analysis are presented in Table 2 at one extreme are countries with a high level of primary energy consumption, the second - the majority of developing countries and suffer from energy poverty and backwardness.

Table 2

**Cluster distribution of countries in terms of power consumption  
(Elec. Cons.), Total primary energy supply (TPES), and emission of CO<sub>2</sub>  
(in 2011) (developed by author)**

№ of cluster	Countries	Range of values*		
		Elec. Cons. (TWh)	TPES (Mtoe)	CO <sub>2</sub> Emissions (Mt of CO <sub>2</sub> )
1	2.3. People's Republic of China.	4432,9	2727,7	7954,6
2	1.2. United States.	4127,3	2191,72	5287,2
3	2.3. India; 1.3. Japan; 3.1. Russian Federation.	835,4 - 1003,1	461,5 - 749,5	1186,0 - 1745,1
4	1.1. Germany.	579,21	311,77	747,6
5	1.2. Canada; 2.3. Korea; 2.2. Brazil.	408,1 - 565,7	251,9 - 270,0	408,0 - 587,7
6	2.2. Mexico; 2.3. Indonesia, Islamic Republic of Iran, Saudi Arabia; 1.3. Australia; 2.1. South Africa; 1.1. Italy, Great Britain; (8 countries).	165,7 - 346,2	122,9 - 212,2	367,6 - 521,0
7	1.1. Poland, France, Spain; <b>3.1. Ukraine</b> ; 2.3. Turkey, Thailand; 2.1. Chinese Taipei (7 countries).	126,4 - 258,5	101,3 - 136,1	243,2 - 311,8
8	2.2. Argentina, Venezuela; 1.1. Netherlands, Belgium; 2.3. Malaysia, United Arab Emirates, Vietnam, Pakistan; 2.1. Egypt; Nigeria, 3.1. Kazakhstan (10 countries).	79,1 - 138,4	59,1 - 84,8	108,6 - 234,2
9	2.2. Chile, Philippines; 1.1. Austria, Finland, Romania, Greece, Slovak Republic, Sweden; 2.3. Kuwait; 2.3. Iraq; 3.1. Uzbekistan; 1.3. Norway (12 countries).	41,2 - 132,6	26,7 - 49,0	38,1 - 112,7
10	2.2. Colombia, Singapore, Peru; 1.3. Israel, New Zealand; 3.1. Belarus, Turkmenistan; 2.3. DPR of Korea, Oman, Syria, Bangladesh; 2.1. Nigeria, Hong Kong (China), Morocco, Libya, Trinidad and Tobago; 1.1. Bulgaria, Hungary, Denmark, Portugal, Switzerland, Slovak Republic; 3.2. Serbia (25 countries).	8,4 - 62,7	13,2 - 118,3	30,3 - 71,8
11	Other (68 countries).	0,2 - 18,2	0,2 - 34,1	0,5 - 30,93

*Note: 1) calculated according to the World Energy Statistics data [16, 17]; 2) units are according to IEA; 3) the numbers indicate the countries' affiliation according to their geographical location and type of economic development model, namely: 1. developed countries; 1.1. Europe; 1.2. America; 1.3. other countries; 2. developing countries; 2.1. Africa; 2.2. America; 2.3. Asia and Oceania; 3. countries with transitional economy; 3.1. post-Soviet countries; 3.2. Other countries; 4) Cluster analysis was performed using the method of Ward.*

Table 2 shows that the current state of world energy consumption determines the country of clusters of 1 - 5, namely: China, United States, India, Japan, Russian

Federation, Germany and etcetera. A countries' BRIC (Brazil, Russian Federation, India and China) is the basis of these clusters.

Analysis changes of the leaders in the overall values of environmental and energy indicators for SD of the world (Table 3) show that during the 2000-2011 years growing regional power imbalances. For example, in 2011 the consumption TPES only China and the United States account for 37.5% and electricity consumption - 41.9 % of the world level. During the 2000-2011 years China's share in the values of these indices is growing. At the same time, the United States' share in the values of these indicators is reduced. This trend is a risk factor for the emergence of global conflict. The constant increase in the proportion of all indicators showed China and India, which caused them to increase GDP. At the same time, despite the increase in GDP other 129 countries of all world level, the share of energy consumption is reduced by these countries.

On the one hand this is due to a decrease in consumption of traditional energy resources in Europe and Eurasia, and the other - increasing energy poverty of underdeveloped countries.

According to British Petroleum (*BP*) [18] world gas consumption in 2013 increased by 1.4%. Gainers gas consumption were China and the United States. World consumption of oil since 2007, grew by only 3 % or 890 thousand. Barrels per day by increasing consumption in China (+ 5% or 470 thousand Bpd) and in Japan (+ 6,3 % or 250 thousand. bpd), which exceeded the decline in oil consumption in Europe and North America. In the future, the share of gas will grow, and this growth is increasingly carried out not only by traditional natural gas production, but also due to unconventional deposits – shale gas, coal bed methane strata of methane hydrates.

Thus, according to BP, the United States shale gas in 2006 increased six-fold in 2011 was almost 200 billion m<sup>3</sup>. This allowed the United States to take second place in the ranking of the world's producers of natural gas. On the agenda is another gas revolution - methane hydrate, whose foundations are laid today in Japan, Canada and United States.

In modern terms the interdependence between producers of the member states of transit countries and consumer countries has increased significantly. Any negative processes in the territory of one of the most influential of the global or regional energy markets, leading to destabilization of the latter. For example, an increase in armed uprisings and conflicts in countries exporting oil and gas (Syria, Libya, Egypt, Iran, etc.) reduces the supply of hydrocarbons and limits diversification of supply.

**Changes of the country-leaders in the overall values of environmental and energy indicators for SD of the World (developed by author)**

Year	The value of the share indicators (% of world total)					
	Population	GDP PPP* <sup>3</sup>	Energy Prod.	TPES	Elec. Cons.	CO2 Emissions
<i>People's Republic of China</i>						
2000	21,07	11,31	11,0	11,30	8,88	12,78
2006	20,07	15,09	14,8	16,0	15,4	20,03
2011	19,32	14,18	18,42	20,80	21,72	25,38
<i>United States</i>						
2000	4,57	21,52	16,63	22,75	27,01	24,17
2006	4,59	19,57	14,02	19,77	23,32	20,34
2011	4,48	18,81	13,52	16,71	20,22	16,87
<i>India</i>						
2000	16,87	5,38	4,18	4,96	2,83	4,00
2006	16,98	6,38	3,69	4,82	3,21	4,46
2011	17,84	5,66	4,10	5,72	4,09	5,57
<i>Russian Federation</i>						
2000	0,26	2,66	9,59	6,07	5,40	6,42
2006	2,18	2,56	10,34	5,76	5,02	5,67
2011	2,03	2,99	9,96	5,57	4,54	5,27
<i>Japan</i>						
2000	2,11	7,53	1,04	5,19	7,49	4,93
2006	1,95	6,15	0,86	4,49	6,04	4,33
2011	1,84	5,59	0,39	3,52	4,92	3,78
<i>Canada</i>						
2000	0,51	1,96	3,72	2,48	3,70	2,25
2006	0,50	1,77	3,50	2,30	3,15	1,92
2011	0,50	1,75	3,10	1,92	2,77	1,69
<i>Korea</i>						
2000	0,78	1,56	0,33	1,92	1,98	1,85
2006	0,74	1,76	0,37	1,84	2,24	1,70
2011	0,72	1,95	0,36	1,99	2,48	1,88
<i>Brazil</i>						
2000	2,83	2,84	1,41	1,81	2,34	1,29
2006	2,90	2,57	1,75	1,91	2,24	1,19
2011	2,83	2,87	1,89	2,06	2,35	1,3
<i>Germany</i>						
2000	1,36	4,58	1,33	3,36	3,89	3,55
2006	1,26	3,92	1,16	2,97	3,40	2,94
2011	1,18	4,02	0,94	2,38	2,84	2,39
<i>Other 129 countries</i>						
2000	49,64	40,66	50,77	40,16	36,48	38,76
2006	48,83	40,23	49,51	40,14	35,98	37,42
2011	44,76	42,18	47,32	39,33	34,07	35,87
<i>World</i>						
2000	<b>100</b>	<b>100</b>	<b>100</b>	<b>100</b>	<b>100</b>	<b>100</b>
2006	<b>100</b>	<b>100</b>	<b>100</b>	<b>100</b>	<b>100</b>	<b>100</b>
2011	<b>100</b>	<b>100</b>	<b>100</b>	<b>100</b>	<b>100</b>	<b>100</b>

Note: compiled and calculated according to the World Energy Statistics data [15-17].

Common energy risk factor for SD of the World and Ukraine can be defined,

namely:

- *urgent need in investments* (In order to reduce the depreciation of Ukrainian pipeline infrastructure to 50% we will need to invest at least 150 billion dollars over the next 10 years. The political instability has discouraged new investments and prevented the renovation of old infrastructures);

- *concentration of main deposits of fuel and energy resources in several countries*;

- *growth of import dependence* (In 2012 through the territory of Ukraine was carried out over 60% of total natural gas transit from the Russian Federation to Western markets. After commissioning in 2012 of the pipeline "Nord Stream" design capacity of 55 billion m<sup>3</sup> per year, Ukraine for 2012-2013 transit volumes lost in excess of 20 billion m<sup>3</sup> per year);

- *growth of global demand for fuel and energy resources* (this demand is expected to grow about 60% by 2030, herewith oil demand growth will be about 1,6% annually);

- *fluctuation of oil and natural gas prices*;

- *insufficient development of competitive European energy markets* (only the existence of such markets is able to provide citizens and companies of European Union the supply safety and more reasonable prices. Achievement of this goal requires developed interrelations, efficient legislation, establishment and use in practice of regulatory frameworks, including the community rules on competition, but consolidation of energy sector has to have a market nature);

- *negative influence on the food security condition* (In the recent years in Ukraine the rapeseed crop areas have significantly and unreasonably increased, mainly due to grain. Agro-climatic zoning of culture has not been taken into account, soils were depleted. This may result in reduction of collecting grain and other crops. Due to rape export-oriented cultivation, the state also loses the potential benefits from biofuel production and its use for partial replacement of traditional fuels in the country that could encourage reduce of the greenhouse gas (GHG) emissions, increase the energy security and, thus, expand the surplus quotas amount which should have been sold on the international carbon market);

- *significant warming as a result increase rate of consumption of coal and oil.*

Further within creasing rate of consumption of coal and oil will lead to higher emissions of CO<sub>2</sub>. Recently, ecological pollution and the related global warming have become one of the most important problems, which solving all the World countries' social development is dependent on. The share of energy emissions is nearly 75% of total amount of emissions into the atmosphere. According to the International energy agency (IEA) [15] worldwide CO<sub>2</sub> emissions had increased from 20,9 gigatons (Gt) in 1990 to 28,8 Gt in 2007, and may reach 34,5 Gt in 2020 and 40,2 Gt in 2030. The CO<sub>2</sub> concentration expected in the Baseline scenario may cause

the increasing of average global temperature on 6<sup>0</sup> C which will definitely lead to large-scale climate changes and will damage the planet irreversibly. Herewith, average annual growth of emissions could reach 1.5 % during the forecast period. At the same time, current research shows that all the energy emissions' increase up to 2030 falls on the countries which are not the OECD members. Three quarters of 11 Gt takes China (where emissions will increase on 6 Gt), India (2Gt) and Middle East (1Gt). The biggest emission reduction is predicted for the OECD countries which is related to decreasing of demand on energy (as a result of the crisis in short-term perspective and significant increase of energy efficiency in the long-term perspective) and wider appliance of nuclear energy and renewable sources, mainly because of already adopted policy which is directed to softening of climate change effects and energy security increase. In all major countries which are not the members of the OECD, on the contrary, emissions increase is predicted.

That is the reason why Energy is the main object of attention and Kyoto protocol appliance. In December 1997 in Kyoto at the third conference of the Framework Convention on Climate Change for the period 2008-2012, the conventional protocol was adopted and named "The Kyoto Protocol". Today it was ratified by 128 States, including Ukraine, the 7% of the global greenhouse gas emissions falls on. Among the countries which have not ratified the Kyoto Protocol are such big atmosphere pollutants as USA and China. At the same time, according to the data represented in the Table 3, the CO<sub>2</sub> emission rate only for these two countries is 42,3% of the World rate in 2011. Herewith, the specific feature of the China development is CO<sub>2</sub> emission rate increase in almost four times pertaining to GDP growth.

In Ukraine approximately 80 % of all types of air pollution is a result of energy processes (extraction, processing and use of energy). The level of energy eco-destructive impact depends on the maintenance of the infrastructure for production, processing and use of energy. The pipelines' length in Ukraine is 17,000 miles, and the level of depreciation is 70%. The electricity generation systems cause undesirable side effects, the worst being health disorders and deterioration of the environment, mainly due to the use of fossil fuels in energy production. Fossil fuels power plants emit dangerous and harmful gases (CO<sub>2</sub>, SO<sub>2</sub>, NO<sub>x</sub>, etc.), which have negative impact on the environment and on human health.

Global climate changes which happen today may be ones of the most important sources of potential risks for Ukraine's SD, namely:

- *climate anomalies' frequency and intensity increase and extreme weather phenomena.* (there is a tendency to a permanent increase in the abnormal temperature fluctuations' frequency and intensity, snow, rain, floods, hurricane winds, unfavorable for economic activity of season river flow redistribution, etc.);



- *droughts, which are genetically inherent for Ukraine's climate, are becoming more frequent and more intensive* (very often droughts appear in areas with better land, where production of bulk commodity grain is concentrated. Along with other anthropogenic factors increasing number of droughts in regions with natural rainfall deficiency can lead to desertification. This tendency lasts for a long time);

- *development of carbon protectionism in major markets of Ukraine's export and, as a result, reduction of the national economy's competitiveness* (adoption of international political and economic decisions to prevent climate change will significantly influence on the financial flows of Ukraine's and other countries' where the significant part of the economy pertains to coal, carbon-containing products, or the countries which depend on sales of goods transported over long distances);

- *aggravation of the water supply problems in Southern and South-Eastern regions of Ukraine*, which already suffer from drought in summer, and where the population is the worst provided with good quality drinking water;

- *further spreading of new agricultural plants' diseases, insects* (locust invasion, caterpillars and other insects, not typical for the temperate latitudes) as well as *weed appearance* caused by the climate change. Possible reduction of soil fertility (since the warming accelerates growth of plants which causes CO<sub>2</sub> absorption, probably will not be able to compensate accelerated decomposition of organic matter);

- *increased morbidity and mortality due to changes in temperature regime, appearance of new diseases* (the biggest impact of heat stress will be seen in the cities, where the most vulnerable population groups (elderly, children, people suffering from cardiac diseases, etc.) will suffer).

**Conclusions and further researches directions.** The major sources of the world "energy" conflicts' appearance are: geographically and politically conditioned inequality of the access to stocks of traditional fossil energy raw materials; significant impact of political, financial and economic risks on the formation of world prices for oil and gas, which in turn is an instrument of the countries-producers' (agent-countries, transit-countries) "energy blackmail". According to the results of cluster analysis at one extreme are countries with a high level of primary energy consumption, the second - the majority of developing countries and suffer from energy poverty and backwardness.

The described above SD problems caused by the climate changes in many countries, including Ukraine, require a steep increase in the natural resources' usage efficiency, adoption of the new nontraditional solutions and mechanisms to ensure energy safety which will be able to solve the electric power shortage problem, reduce harmful environmental load and renovate Energy according to requirements of the XXI century in the shortest possible time and with minimal costs. In addition, with the expansion of risky situations' zones the Risk Management becomes objectively a

vitally important management element, the most important precondition for successful business. Permanent price growth for energy resources and Ukraine's dependence from their import already forces us to start solving energy safety, energy efficiency and energy saving issues. Mechanisms of Risk Management and incentives making energy wastefulness thriveless should be created and implemented in all spheres of life.

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**ГЛОБАЛЬНІ ЕНЕРГЕТИЧНІ КОНФЛІКТИ ТА РИЗИКИ СТАЛОГО РОЗВИТКУ В  
РЕЗУЛЬТАТІ ЗМІНИ КЛІМАТУ**

**Караєва Наталія Веніамінівна**

*PhD, доцент теплоенергетичного факультету Національного технічного університету  
України «Київський політехнічний інститут», Україна*

*Стаття присвячена аналізу загроз і ризиків сталого розвитку світу та України внаслідок зміни клімату в контексті традиційної енергетики. На основі результатів кластерного аналізу визначено джерела виникнення конфліктів між основними гравцями глобального енергетичного ринку. Досліджено динаміку зміни країн-лідерів у загальних значеннях еколого-енергетичних індикаторів сталого розвитку світу на протязі 2000-2011 рр. Визначені потенційні ризики сталого розвитку України в результаті зміни клімату.*

**Ключові слова:** *сталий розвиток, енергетичні конфлікти, ризики, зміна клімату, емісія CO<sub>2</sub>.*

**ГЛОБАЛЬНЫЕ ЭНЕРГЕТИЧЕСКИЕ КОНФЛИКТЫ И РИСКИ УСТОЙЧИВОГО  
РАЗВИТИЯ В РЕЗУЛЬТАТЕ ИЗМЕНЕНИЯ КЛИМАТА**

**Караева Наталья Вениаминовна**

*PhD, доцент теплоэнергетического факультета Национального технического  
университета Украины «Киевский политехнический институт», Украина*

*Статья посвящена анализу угроз и рисков устойчивого развития мира и Украины в результате изменения климата в контексте традиционной энергетики. На основе результатов кластерного анализа определены источники возникновения конфликтов между основными игроками глобального энергетического рынка. Исследована динамика изменения стран-лидеров в общих значениях эколого-энергетических индикаторов устойчивого развития мира за 2000-2011 гг. Определены потенциальные риски устойчивого развития Украины в результате изменения климата.*

**Ключевые слова:** *устойчивое развитие, энергетические конфликты, риски, изменение климата, эмиссия CO<sub>2</sub>.*