ECOLOGICAL SAFETY OF THE REGIONS: ACHIEVING THE EU STANDARDS

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On the basis of comparative analysis of the results of economic, production and environmental activity and indexes that testify the quality of life in context of environment of European countries the main trends of maintaining the ecological safety of the regions were defined. The crucial issues should be solved in the framework of providing the high level of ecological safety of the regions in globalization and integration conditions are discovered. The main directions for pre-ins countries in achieving the EU standards of environmental protection were proposed.

INTRODUCTION

Ecology as one of the most crucial issue of today's reality which reflects the influence of human activity in different fields on the environment requires more and more attention from both scientists and experts. Only in 2002-2007 in Ukraine the level of CO_2 emissions has increased on 12% per capita. Of course the leaders in this field are industrially developed regions (Donets'k, Lugans'k and Dnipropetrovs'k). Another trend existed in this field in Ukraine is directing more than 72% of funds granted for ecological actions on elimination of consequences of harmful influence on the environment [1, 2]. At the same time in accordance to programs of EU [3] the priorities of maintaining the ecological safety in all EU regions emphasizes on prevention of harmful influence rather that on liquidation of consequences of this influence (in contradiction, in Ukraine the preventive ecological actions obtain only 0,52 % of total funds directed on the ecology). And in this case the question is not in lack of financial resources but in lack of willingness of business owner to invest into ecology [4, 5]. Taking into account the ecological priorities of the EU countries Ukraine attempting to enter the EU through association should develop an effective mechanism of achieving the EU standards of environmental protection.

Critical analysis of researches in this field let define the several essential directions of researches: co-operation and correlation between level of development of economic systems and their ecological safety [7, 8, 11, 12, 17, 19], decision making with accounting of ecological components [13, 14, 20], institutional [10, 15], social [16] factors, introducing the ecology accounting [6], financial mechanism of realization of ecological projects [9, 18], etc.

Today in the framework of European integration of Ukraine it's necessary to develop concrete directions of achieving the EU standards not only by creation the corresponded legislation [3], but also by defining and providing the proper direction in changing the parameters that testifies the influence of human activity on ecology.

In this context the goal that should be achieved in the presented research is to define the basic trends of maintaining the ecological safety of EU regions and to propose the main directions for pre-ins countries in achieving the EU standards of environmental protection.

1. BASIC PARAMETERS OF ECOLOGICAL SAFTY OF EUROPEAN REGIONS: TRENDS AND CHALLANGIES.

In order to solve the settled problem the following indexes were selected: GNI, GDP, electric power consumption, and life expectancy at birth, CO_2 emission, energy use, high-technology exports, health expenditures, population growth. The basic tools used for analysis are cluster and trend analysis for selected EU countries, Norway, Ukraine, Switzerland and Russia, experts' assessment of importance of basic parameters of ecological safety of the region.

The basis for defining ecological clusters was the following correlations: GNI per capita vs. electric power consumption; high-technology exports vs. energy use; GDP per capita vs. GDP per unit of energy use; GNI per capita vs. life expectancy at birth; life expectancy at birth vs. CO_2 emis-

sion per capita; GDP per capita vs. CO_2 emission per capita; GDP per unit of energy use vs. CO_2 emission per capita.

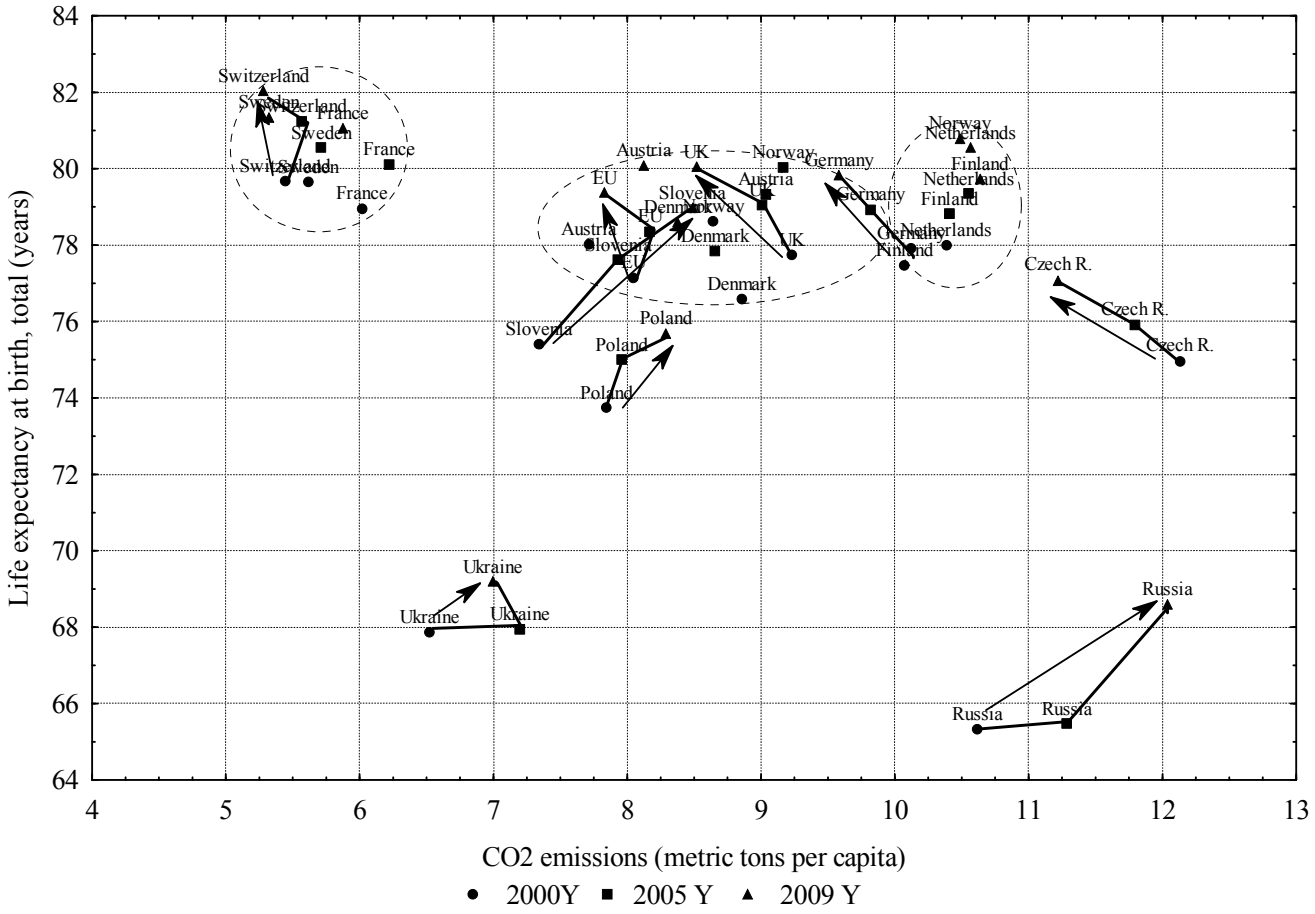
The historical series analysis used for defining closeness of country's trends to EU trends was concentrated on the following correlations: growth of GNI per capita vs. growth of electric power consumption; growth of GDP per capita vs. growth of GDP per unit of energy use; growth of GDP per unit of energy use vs. growth of CO_2 emission per capita; growth of life expectancy at birth vs. growth of CO_2 emission per capita; growth of GNI per capita vs. growth of life expectancy at birth; growth of GNI per capita vs. growth of health expenditures per capita; changes in growth of population vs. growth of CO_2 emission per capita; changes in high-technology exports vs. growth of GNI per capita. Composition of the following components of model were integrated by ranking of experts' evaluation.

The main assumptions accepted for analysis were the following:

- periods to be analyzed were 2000, 2005 and 2009 years according to calculations of the World Bank [21];

- all ecological direct (CO_2 emission, energy use, electric power consumption) and indirect (life expectancy at birth, population growth) indexes should be analyzed from the economic point of view because from the one hand exactly economic and production activity of human make a significant even determinative influence on ecology, and from the other hand highly efficient economic activity provides the funds for implementing the ecological improvements.

Analysis of distribution of EU countries by correlation of CO_2 emission and life expectancy at birth lets define three principle groups of counties (Fig. 1).



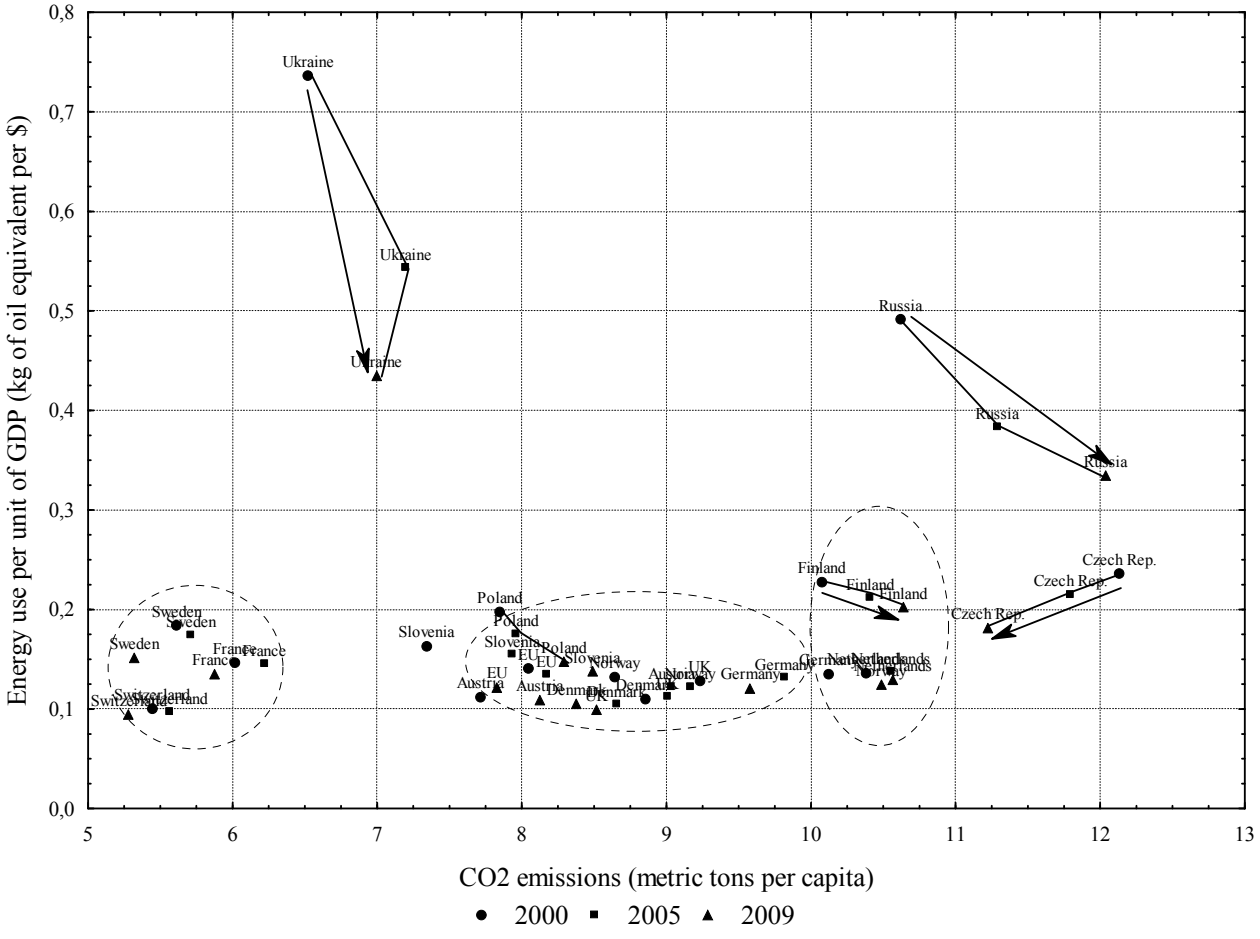
Source: calculated on the basis of the World Bank Data [21].

Fig.1. Clusterization of countries by the level of CO_2 emission and life expectancy at birth

The first one includes countries with quite low level of CO_2 emission (less than 6.3 metric tones per capita) and high level of life expectancy at birth (over 79 years). All countries of the first cluster (France, Sweden and Switzerland) during 2000-2009 years have been staying in the same cluster. Moreover, each country has significantly improve their position by reduction of CO_2 emission to lower than 6 metric tones per capita and increase the level of life expectancy at birth over 80 years. The second cluster presents countries (including EU average) with average level of life expectancy at birth 79.5 years and variation of CO_2 emission from 7.7 up to 10.0 metric tones per capita. It should be mentioned that overall trend in this cluster are practically the same as in the first one – reduction of CO_2 emission and increase in life expectancy (except Austria). Special attention should be paid to Slovenia which entered the second cluster in 2005 and quickly achieve the EU average both in CO_2 emission and life expectancy. On the same way is Poland, which moves toward the cluster II extremely fast and at the end of 2009 were on the boarder position.

The third cluster presents countries with EU average level of life expectancy and higher level of CO_2 emission – ecology risky cluster and includes Finland, Netherlands and in 2000 – Germany. The interest changes were in this cluster. Namely Norway, which was on the EU average level by both parameters during 2000-2009 years has left the II cluster and rapidly move to the top of III cluster. Totally opposite trend was resided to Germany, which passes from the III cluster to the second one. Ukraine and Russia were on special position: lowest level of life expectancy and increase of CO_2 emission. But the trend of Ukraine testifies the slow movement toward cluster II. Position of Russia reflects the increasing level of ecological risk and worsening the environmental conditions, that leads to decrease in quality of life for the citizens.

In order to define the economical basis for increase of level of CO_2 emission and to testify the validity of such changes countries were distributed by clusters by correlation between CO_2 emission and energy use per unit of GDP (Fig. 2).



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ource: calculated on the basis of the World Bank Data [21].

Fig.2. Clusterization of countries by the level of CO2 emission and energy use per unit of GDP

As it shown on the Fig. 2 the same three clusters exist in energy use:

- I - "Low CO2 emission & Low energy use" – France, Sweden, Switzerland;
- II – "EU average" – UK, Austria, Denmark plus countries entered into cluster (Poland, Slovenia) and transitory countries (Germany – from III to II, Norway – from II to III);
- III – "Risky countries" – Finland, Netherlands, Norway;
- out of clusters countries: Czech Republic (pre-ins to III cluster), Russia and Ukraine.

Unfortunately Ukraine obtained the last position in the energy use efficiency. In spite of serious declining in energy use per $ of GDP the current level is far form EU average and even from Russia, which does not suffer from lack of energy resources instead of Ukraine. Irrational use of energy in the most cases is only "the top of iceberg" which illuminates the problems corresponded to efficiency of business maintaining, irrational institutional structure, lack of stimulators and motivators for investors to increase the energy use efficiency. Table 1 presents ranking of countries by the level of intensity of development in rational energy use.

Table 1

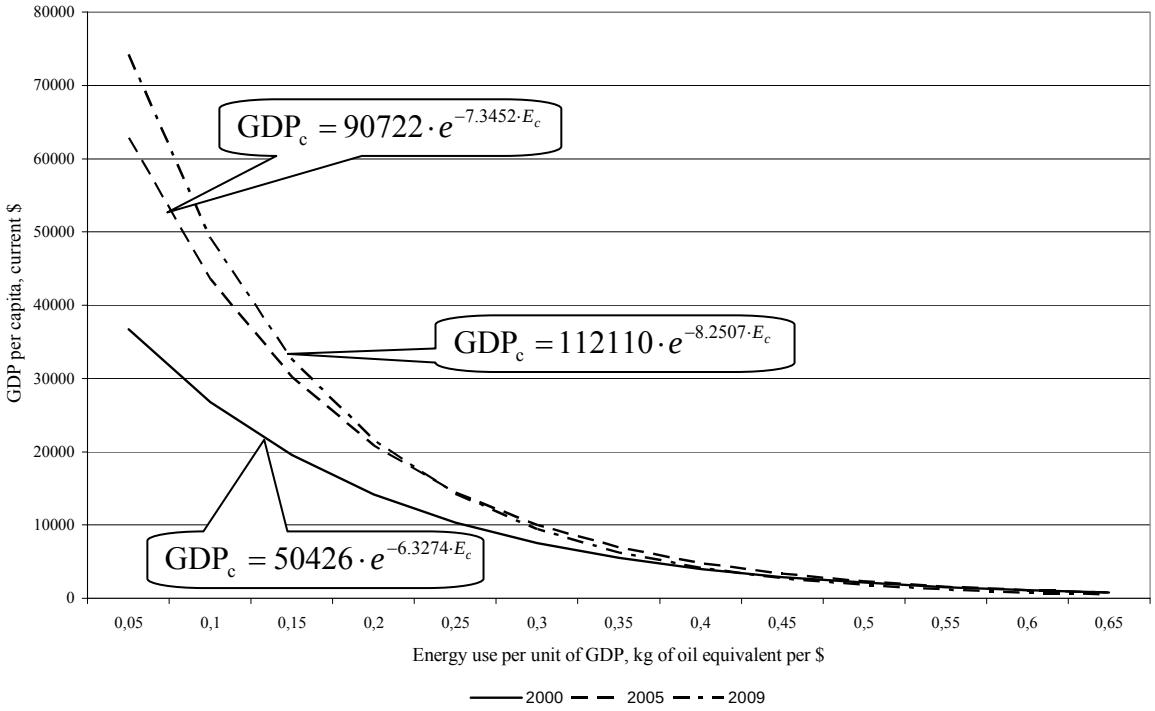
Level of intensity of development in rational energy use

Country	ΔCO_2 emissions per capita	Δ GDP per capita weighted on EU average	Level of intensity of development*
Austria	0,053	1,266	3
Czech Republic	-0,075	1,272	1
Denmark	-0,054	1,485	1
Finland	0,056	1,268	3
France	-0,024	1,077	1
Germany	-0,053	0,934	1
Netherlands	0,017	1,451	3
Norway	0,213	2,471	3-R
Poland	0,057	0,531	4
Russia	0,134	1,019	3-R
Slovenia	0,156	1,029	3-R
Sweden	-0,052	0,746	2
Switzerland	-0,029	1,615	1
Ukraine	0,072	0,235	4
UK	-0,077	0,433	2

Source: calculated on the basis of the World Bank Data [21].

Level of intensity of development is defined as ratio of Δ GDP to ΔCO_2 emissions per capita and distributed on the basis of GDP "EU average" and zero level of ΔCO_2 emissions. So the rank "1" can be obtained by the country with reduction in CO_2 emissions and significant (over EU average) level of increase in GDP per capita. The rank "2"peculiar to countries with reduction in CO_2 emissions and increase in GDP per capita (lower than EU average). Cluster 3 should be divided into to sub-clusters: "3" (increase in CO_2 emissions and significant (over EU average) increase in GDP per capita) and "3-Risky" (increase in CO_2 emissions exceed 10% and significant (over EU average) increase in GDP per capita). The last sub-cluster reflects the quite high "price" for environment for GDP growth. And the forth cluster (presented by Poland and Ukraine) shows the low level of growth of GDP per capita and increase in CO_2 emissions.

Analysis of efficiency of energy use makes possible to settle clear correlation between GDP per capita and energy use per unite of GDP (Fig. 3). The level of reliability of the defined correlations varies form 0.7589 to 0.8947. Defined correlations show that proper increase in GDP can't be achieved without rational use of energy. It should be mentioned that significant increase in GDP per capita can be achieved for example for Ukraine by reducing the energy use from current 0.435 to 0.350 as minimum. The following declining may lead to extremely fast growth of GDP per capita and from year to year this trend accelerates (if in 2000 decline in energy use from 0.45 to 0.35 provides growth of GDP in 1.9 times, in 2009 the same declining leads to increase in GDP per capita in 2.28 times).



Source: calculated on the basis of the World Bank Data [21].

Fig. 3. Correlation of GDP per capita and Energy use per unit of GDP

Moreover, in modern conditions when the price for energy (especially gas and oil) going up the problem of implementation of high-technologies on energy saving and rational use of nature is extremely important. But almost over-EU trend is declining the share of high-technology products in total export. Against a background of EU average declining on 5.93% of share of export of high-technology products in total export during 2000-2009, such countries as UK, Finland and Netherlands decrease this level to -10,5%, -13,4% and -14,9% correspondently. At the same time Czech Republic increase this share from 8.5% in 2000 up to 14.6 in 2009 (progress of Poland form 3.36 to 6.10, Ukraine 5.23 to 5.55).

So, taking into account defined trends and distribution of countries by the selected indexes, and quite tight direct and implicit correlation between ecological and economic indexes, it is possible to assess the integrated index of ecological safety of the country and level of closeness to EU standards of ecological safety based on comparison of rate of growth of countries' indexes toward EU level.

2. LEVEL OF ECOLOGICAL SAFTY: ASSESSMENT AND DIRECTIONS FOR IMPROVEMENT

The integrated index of ecological safety of the country based on the composition of experts' evaluation of importance of the given indexes, statistical assessment of closeness of correlation between indexes analyzed in the model and distribution of countries between clusters of ecological safety. Ranking of importance of each of 7 ratios varies from 0 to10 with possibility of use of fractional values (volume of samples – 45).

Complex use of experts' evaluation of importance corrected by evaluation of level of closeness of correlation between indexes lets develop the following rank of weights of indexes included in the assessment model (Tab. 2). As it shown, the biggest weight belongs to tree key factors of ecological safety: correlation between level of population growth and level of CO_2 emission, life expectancy and level of CO_2 emission, level of energy use per unit of GDP and GDP per capita.

Table 2

Rank of weights of indexes included in the assessment of integrated index of ecological safety

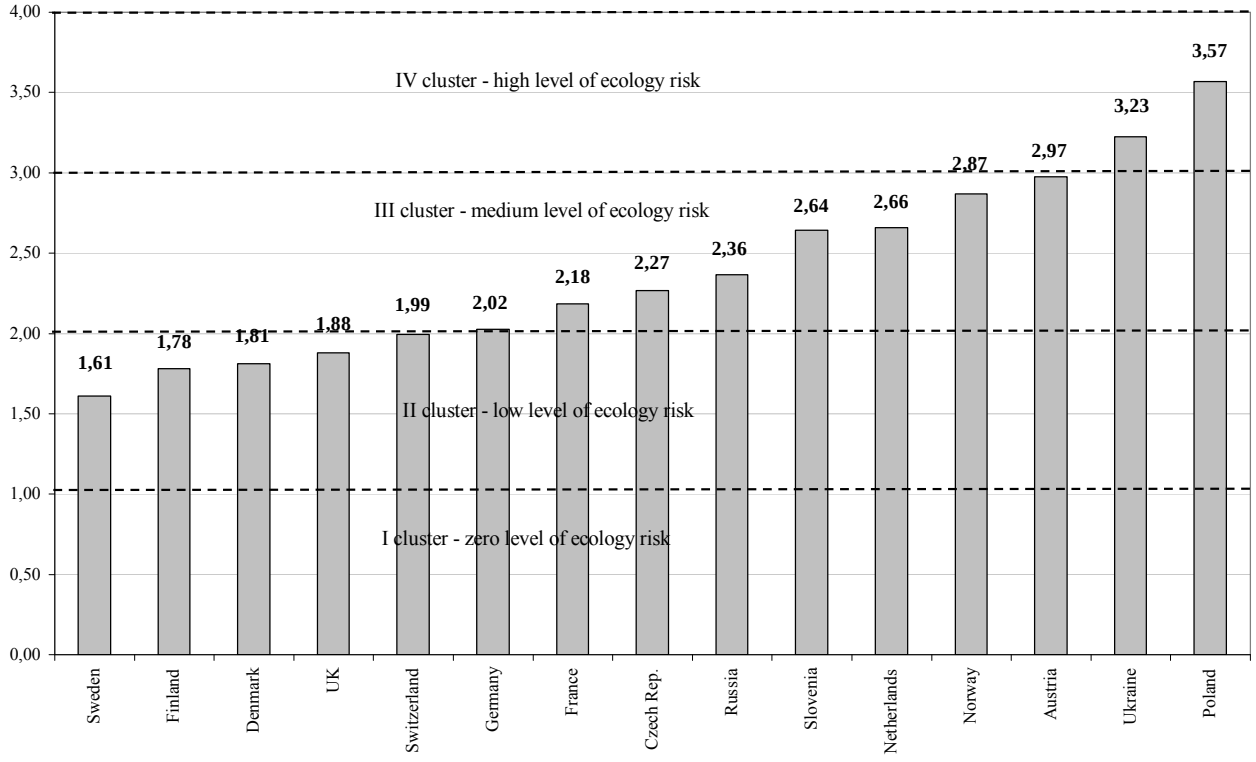
Index	Weight of index
Population growth / CO_2 emission	9,9972
Life expectancy / CO_2 emission	9,9467
Energy use per unit of GDP / GDP per capita	9,1576
GDP per unit of energy use / CO_2 emission	8,9768
Life expectancy / GNI per capita	8,1649
Electric power consumption / GNI per capita	6,6795
Health expenditures / GNI per capita	5,1973

Source: own researches.

Clusterization of the countries was conducted on the basis of the assumptions:

- the basic principle of assessment is based on priority of ecology safety over economic development;
- all countries should be distributed between four clusters by level of ecology safety (1- most safe position; 4 – most risky position).
- all indexes should be considered in dynamics comparing 2009 to 2000 years;
- for ratios that involve level of CO_2 emission (Population growth / CO_2 emission, Life expectancy / CO_2 emission and GDP per unit of energy use / CO_2 emission) zero level is set on zero X-Y-point for other indexes the EU average is a zero level;
- the integrated index should be calculated as weighted average value.

In the result of conducted calculations the integrated index of ecological safety for different countries was determined on the following levels (Fig. 4).



Source: calculations on the basis of the World Bank Data [21] and own researches.

Fig. 4. Ranking of countries by level of ecological safety in 2009

As it shown on the figure 4 the best ecological conditions are in Sweden, Finland, Denmark and Switzerland, whose rank varies in interval form 1.0 (zero level of ecology risk) to 2.0 and present the cluster of low level of ecology risk with positive economic development.

The third cluster of ecological safety is presented by eight countries, which can be divided into two groups: "Medium" group with rank lower that 2.5 (Germany, France, Czech Republic and Russia) and "Medium+" group with rank higher than 2.5 (Slovenia, Netherlands, Norway and Austria). Such differentiation is necessary for defining disposition of country toward increasing the ecological risk and reducing the level of ecological safety. But it should be mentioned that integrated index is just a illuminator of trends and possible problems. Including, for example Netherlands, in Medium+ category of risk caused is not by high level of CO_2 emission or high level of energy use, as negative level of population growth cased by social and mental factors.

The forth cluster which includes countries with high level of risk and correspondently low level of ecological safety is presented by Ukraine (3.23) and Poland (3.57). Presence in this cluster shows the inadequate worsening of ecological conditions comparing to economic growth and social development.

Movement of countries between clusters reflects the changes in balance between ecological and economic development. In this case the crucial issue is to define moments and causes of increase in ecological risk and to control the dynamics of change in level of ecological safety. For this purpose implementation of ecological control system based on ecological accounting [6] is one of the most essential steps of ecological management.

Many years of labor-intensive work of different EU organizations and scientists provides the wide legislative, theoretical, methodical and practical basis for defining the proper standards of ecological safety. That's why the crucial issue not only for pre-ins countries but for all members of EU to reach the defined standards both in ecological and economic-social fields.

In order to assess the level of closeness of different countries to EU standards of ecological safety the following approach was proposed. The assessment of level of closeness was based on comparison of countries' indexes with EU level. The same procedure as was proposed for assessment of level of ecology safety. The difference consists in that all indexes should by assessed separately comparing to rate of growth of given index in EU. The weights of selected

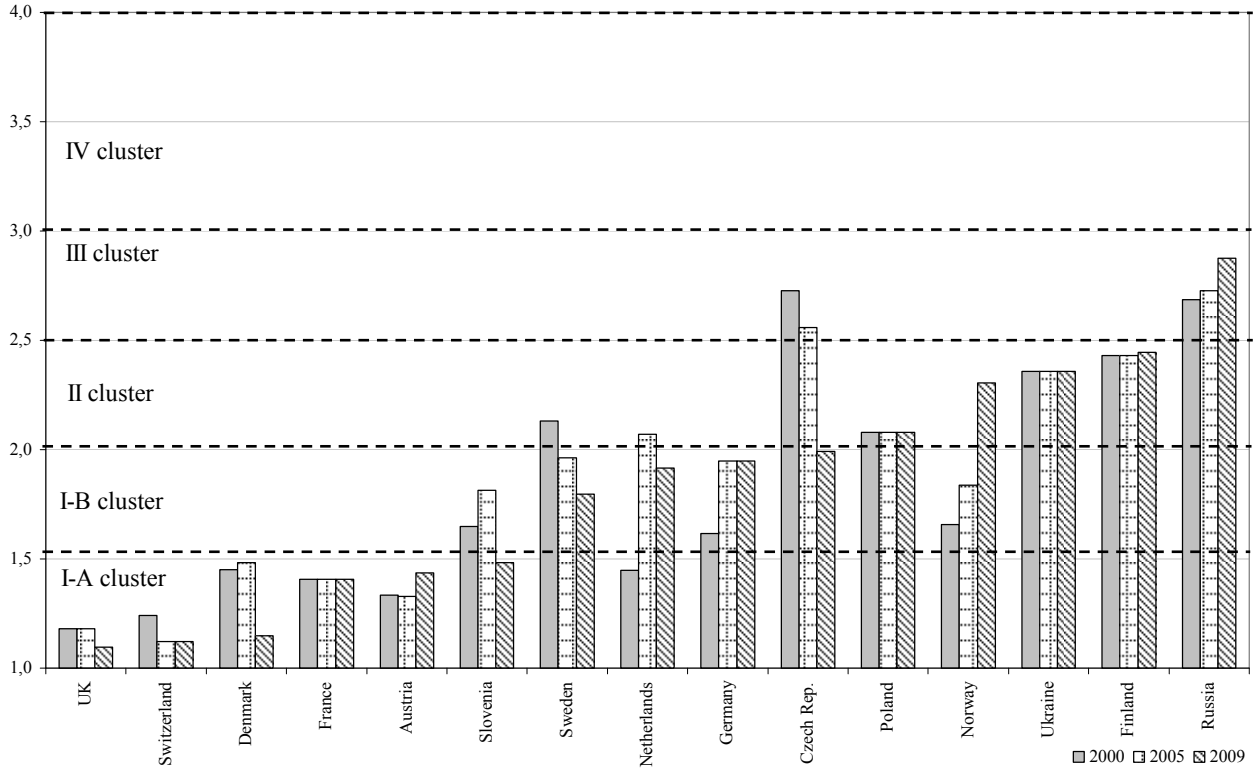
Table 3

Rank of weights of indexes included in the assessment of level of closeness of the country to EU standards of ecological safety

Index	Weigh of index
Δ CO2 emissions (metric tons per capita)	9,9847
Δ Population growth (annual %)	9,2345
Δ Life expectancy at birth, total (years)	8,2245
Δ Energy use (kg of oil equivalent per capita)	8,1976
Δ GDP per unit of energy use ($ per kg of oil equivalent)	7,6877
Δ Electric power consumption (kWh per capita)	6,6953
Δ Health expenditure per capita	5,3971

More over such indexes as Δ CO2 emissions, Δ Energy use and Δ Electric power consumption, growth of which is a negative trend, were assessed on the basis of principle of "the lower – the better". Assessment of other indexes was based on "the higher – the better". The deviations of calculated levels of growth were assessed on the basis of method of 3-σ that leads to possibility to distribute in four clusters (Fig. 5). The boundary values of clusters were:

- I cluster - rank of intense of achieving the EU standards varies from 1.0 up to 2.0 with separation into two sub-clusters: I-A – "most intensive closeness" and I-B – "intensive closeness";
- II cluster - rank of intense of achieving the EU standards varies from 2.0 up to 2.5 and presents countries with medium level of intense;



Source: calculations on the basis of the World Bank Data [21] and own researches.

Fig. 5. Ranking of countries by intense of achieving the EU standards of ecological safety in 2000-2009

- III cluster - rank of intense of achieving the EU standards varies from 2.5 up to 3.0 and presents countries with low level of intense;
- IV cluster - rank of intense of achieving the EU standards varies from 3.0 up to 4.0 and presents countries with practically zero level of intense or even removal from EU standards.

The positive trend which was defined is that all of considered countries are trying to reach EU standards of ecological safety with providing the proper level of economic and social development. But it should be mentioned that, for example Norway has not only left the I-B cluster but move to the second one. Russia having not first position in ecological safety (see Fig. 4) has significantly slowed down the process of achieving the EU standards of ecological safety.

Ecological safety as an integrated index that shows the ability to provide the proper level of quality of environment in strategic perspective requires creation of adequate system management and monitoring. And in this case the crucial issue is cooperation between all countries in solving the ecological problems, implementation of unified approaches, standards and procedures of planning, analyzing, assessing, organizing and control of economic and social development with priority of rational use of environment and providing the long-term ecological safety of the regions.

CONCLUSIONS

The proposed approach to assessment and analysis of level of ecological safety of the countries and level of intense of closeness to EU standards of ecological safety with providing the proper level of economic and social development let define the basic trends in ecological conditions of EU countries and to assess the efforts of other countries to achieve the EU standards.

One of the essential problems which require both scientific and practical solution is finding the proper balance between ecological safety, economic and social development. Priorities, stated in EU documents concerning the ecology, should become guiding lines not only for controlling units

and organizations, not only for governments and local communities but for all members of society. That's why the problem of ecological education becomes urgent and actual. More over implementation of institution of ecological responsibility for business, government, local communities based on EU standards and experience are the required step for pre-ins countries. As the experience of Ukraine showed the acceptance and implementation of action plan targeted on matching the Ukrainian legislation in ecological field to EU's is only first and weak step toward EU standards. Absence of proper institutional structure, misbalances in development of regions and different industries, and even elementary lack of ecological culture, rules and traditions are more essence for solving ecological problems.

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