

РОЗВИТОК ПРОДУКТИВНИХ СИЛ І РЕГІОНАЛЬНА ЕКОНОМІКА

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UKRAINIAN ENERGY SECTOR: ECOLOGICAL AND ECONOMIC FEATURES¹

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Introduction. It is the worldwide fact, that the questions of economic growth and environment are closely connected. Since 1755, when T. Nuikman created the steam engine (KKD was less, weight was huge), despite of non-relating from the natural phenomenon, that engine needed to use the fuel. Even that period of technology development had the huge impact on the environment. Thus, the hundreds steam engines led to the degradation of living conditions in the city provoked by the huge emission of the steam. In the modern world traditionally countries used the thermal, hydro and nuclear electric plants, and the last year the renewable energy has been developing from year to year.

Each above-mentioned type of electricity has the strength and weakness sides. In addition, each type has the corresponding impact on environment. At the first stage the renewable energy is determined like an instrument which doesn't have the negative impact on environment, doesn't use the exhaustible resources. From the other side, in nowadays the new negative impact has been already identified due to using the renewable resources.

The results of analysing showed, that the huge share of Ukrainian energy is generated by the thermal and nuclear energy. In this case the thermal energy produced the most part of emissions. Thus, this paper devoted to analysing the volume of emission from the thermal electricity station. The objective analysing of the volume and structure of impact give opportunity to develop the optimal way of energy transformation from the damaged to the ecological oriented.

Literature review. The questions of optimization the energy production was analysed by the use range of scientists. Thus, Maliarenko and Sherbak [1] analysed the volume of the production and consumption in Ukraine of the following resources: oil, gas, coal and etc. They approved, that it is necessary to develop the electricity system of Ukraine. Besides, Ukraine should decrease the consumption of natural gas and decrease the coal and renewable energy.

At the same time, Veklych and Shlapak [2] analysed the dynamic of the clean internal product which corrected by the ecological damage from the air pollution by the thermal power stations in Ukraine. The highlighted, that Ukrainian green GDP was 95.4% from the traditional assessment. Thus, above mentioned percentage is the "green price" of the strategy to increase GDP without estimating of the ecological factor on

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the national economy function. The same findings were received by O. Kubatko [3]. In his work, he calculated the lost GDP from the environmental pollution and compared it with environmental taxes.

It should be underlined, that a lot of scientists analysed the energy consumption structure at the national level [4] and at the companies [5].

Problem statement. Thus, with the purpose to analyse and to indicate the further directions of the Ukrainian energy sector it is necessary to analyse the structure of energy consumption taking to account the season fluctuating. The findings give the opportunity to estimate the impact of the energy production on the environment.

Basic materials and results. In this article the Ukrainian official statistics datasets were used. The authors analysed the using structure of the energy resources for the thermal electricity power station on the 2013-2017. On base of the findings and calculation methodology the authors analysed the volume of emission of the damage contaminant to the air from the natural gas and coal using.

With purpose to implement the ecological oriented development it should be taken to account the effectiveness of the energy resources and its ecological effect. The results of analysing showed that coal and natural gas are the main sources of pollution in Ukraine. Noticed, the structural proportion between coal and natural gas has the season fluctuations. Thus, in summer the natural gas – 22-25% from the total using of the energy resources, but in winter it equals 50%, figure. 1.

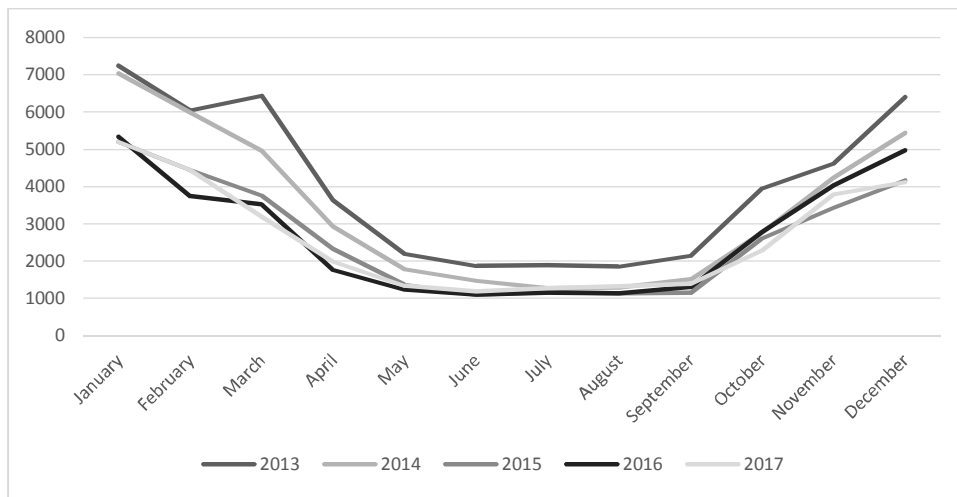


Figure 1 – using of the natural gas in Ukraine 2013-2017, million m3 [7]

From the other side the volume of coal consumption doesn't have the significant correlation from the season, but the share is changing from 45% in winter to 70% in summer, fig. 2. We can assume, that the most part of Ukrainian heating system uses the natural gas and at the same time coal uses in the most daily grind, productions and others spheres.

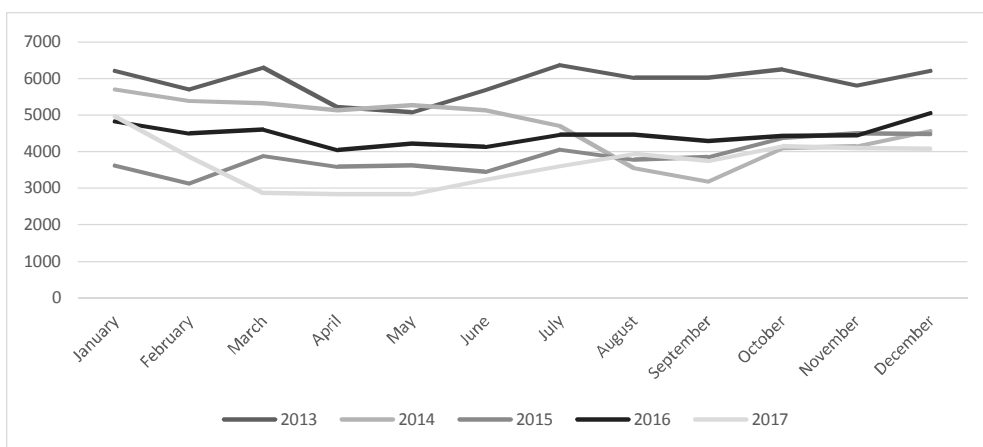


Figure 2 – The using of coal, thousands of tons, 2013-2017 [7]

The results of statistics data showed that the Ukrainian energy consumption is decreasing during last five years and has the stabile tendency of reducing, figure 3. The main reason of that tendency is increasing the price for the energy resources, including coal and natural gas.

According to the Government Ukrainian Statistics and the methodology of calculation of the air pollutions and greenhouse emissions from the stationary sources, the gross emissions to the air could be calculated by the following formula [8]: (1)

$$E_j = 10^{-6} * k_j * B_i * Q_i^r \quad (1)$$

, where E_j – gross emission of the j damage contaminant during the burning of the I fuel for the year, t;

k_j – emission of j contaminant for i fuel, g/MJ;

B_i – using of I fuel during the year, t;

Q_i^r – the lowest working calorific value of I fuel, MJ/kg.

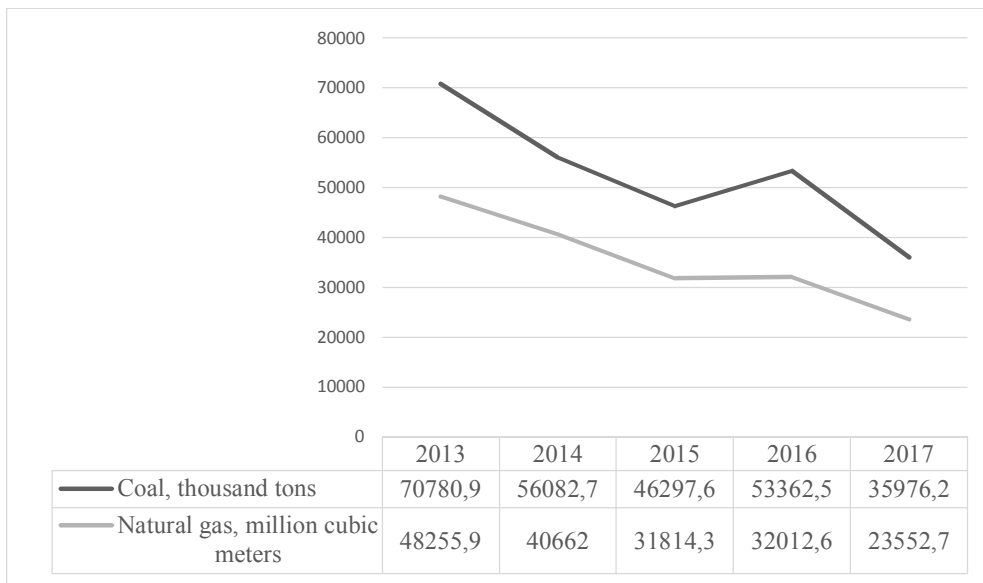


Figure 3 – The volume of energy consumption [7]

The main contaminant which polluting the air during coal and gas consumption are: CO, CH₄, N₂O, C, SO₂, CO₂ and nonmethane volatile organic compounds (NVOC). The emission coefficient changed depends from the type of energy fuel for each contaminant, table 1. Thus, the findings showed the most volume of pollution was been by the C, CO₂SO₂ and CO. It should be underlined, that all above mentioned greenhouse gases have the negative impact on the healthy. In this reason, them are included to the base of ecological taxes which paid by the energy production companies (who uses the coal and natural gas). Noticed that this emission coefficients use only for the stationary sources of pollution (table 1).

Table 1

Emission coefficients by the types of contaminant, g/GJ [6]

Contaminant	Coal	Natural Gas
CO	1871,5	248,75
CO ₂	93740,0	58748,13
CH ₄	1,0	1,0
N ₂ O	1,4	0,1
NO _x	100,90	64,311
SO ₂	2506,0	–
NVOC	600,0	–
C	2305,9	–

Using the data from the table 1 and formula 1 the authors calculated the volume of pollution for each contaminant depends on the fuel's type. Comparing coal and natural gas, the authors made conclusion that the coal is the more environmentally harmful than natural gas. Only CO₂ emissions from the coal using were higher than the fatal emission from the natural gas using. The statistics dataset showed that the emissions from

using of the energy resources has been decreasing continuously correspond to the decreasing of volume consumption of the traditional energy resources.

It should be underlined that spreading and implementing the renewable energy resources will be allowed increasing the volume of energy production (directly) and decreasing the volume of environmental pollution (indirectly). Thus, one solar energy station with power 10 kWt*hours produces 10 200 kWt*hours/year, it's indirectly replace the traditional energy resources. As we wrote above the most part of Ukrainian energy was produced by the thermal (used coal and natural gas) and nuclear (as a consequence – huge radiation) power stations. It is noticed that during last year nuclear power station generated more than 50% of whole energy production. It could be explained by the decreasing the volume of deliveries of natural gas and increasing the costs of coal.

Table 2

The findings of the polluters' volume pollution according to the proposed method, thousands of tons

	2013	2014	2015	2016	2017
Coal					
CO	2 711,59	2 148,51	1 773,64	2 044,30	1 690,71
CO ₂	135 818,48	107 614,73	88 838,51	102 395,05	84 684,57
CH ₄	1,45	1,15	0,95	1,09	0,90
N ₂ O	2,03	1,61	1,33	1,53	1,26
NO _x	146,19	115,83	95,62	110,22	91,15
SO ₂	3 630,91	2 876,92	2 374,97	2 737,38	2 263,92
NVOC	869,33	688,81	568,63	655,40	542,04
C	3 340,98	2 647,20	2 185,33	2 518,80	2 083,15
Total:	146 520,96	116 094,75	95 838,97	110 463,77	91 357,70
Natural Gas					
CO	397,05	334,57	261,77	263,40	258,85
CO ₂	93 772,15	79 015,48	61 822,39	62 207,74	61 133,13
CH ₄	1,60	1,34	1,05	1,06	1,04
N ₂ O	0,16	0,13	0,11	0,11	0,10
NO _x	102,65	86,50	67,68	68,10	66,92
Total:	94 273,60	79 438,02	62 152,99	62 540,40	61 460,05

Calculated by the authors

The results of analysing showed that industry, households and transport were the main energy consumers, table 3. From the other side, these three economic sectors provoked the huge level of the greenhouse emissions.

Table 3

Final energy consumption, thousands of t.u.e. [10]

Economics sector	2010	2011	2012	2013	2014	2015	2016
Industry	25327	26253	24845	21864	20570	16409	14955
%	34,2	34,6	34,0	31,4	33,5	32,3	29,0
Transport	12627	12611	11448	11280	10327	8750	9165
%	17,1	16,6	15,7	16,2	16,8	17,2	17,7
Households	23813	23604	23466	23495	20384	16554	17586
%	32,2	31,1	32,1	33,8	33,2	32,6	34,1
Services	4643	4802	5037	5745	4663	3838	4856
%	6,3	6,3	6,9	8,3	7,6	7,6	9,4
Agriculture, forestry and fish	2036	2246	2195	2242	2016	1961	2142
%	2,8	3,0	3,0	3,2	3,3	3,9	4,1
No energy using of energy	5547	6008	6116	4932	3500	3318	2910
%	7,5	7,9	8,4	7,1	5,7	6,5	5,6
Total	74004	75852	73107	69557	61460	50831	51645

The spreading of renewable energy could decrease the volume of pollutions and be the base for the ecological oriented development. According to the official datasets renewable energy produced 1.56 billion of kWt*h (0,86%) in 2014. There is at the simple way to calculate (using the data from the table 4) the damage for the environment from the energy production. According to the findings, the renewable energy got opportunity to avoid polluting the environment approximately by 50 thousand tons and 27.22 million UAH of economic damage.

Table 4

CO2 in Ukraine [6, 11]

Year	The volume of greenhouse emissions, thousands of t.u.e.	The volume of CO2, thousands of tons	% of CO2 emission in the whole energy production
2000	470107,957	320902,837	39,62
2005	434668,759	333876,683	29,02
2010	393092,0594	304643,359	29,42

The results of analysing showed that that tradition methodology to estimate the potential profit from the renewable resources takes to account only economic factors (volume of energy multiple by price) but doesn't take to account the ecological benefits.

Conclusions. The findings showed that thermal power stations which used coal like a main source are the main polluters in Ukraine among the energy sectors. Thus, the results showed that using of coal has already become not only ecological damage, but non-effective from the economic point of view.

Moreover, the traditional methodology to calculate the benefits of renewable energy takes to account only economic parameters excluding the ecological factors. It could be explained by the decreasing the economic attractiveness due to calculating the ecological side. In this case, it is necessary to adopt the existence methodology of calculating with purpose to estimate all direct/indirect, positive/negative economic and ecological factors under the assessment of renewable energy effectiveness. As a result, the methodology of indicating the ecological tax should be changed corresponding.

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Павлик Анатолій Володимирович, асистент. **Льовов Олексій Валентинович**, к.е.н, доцент кафедри економіки, підприємництва та бізнес-адміністрування. **Чигрин Олена Юрїївна**, к.е.н, доцент кафедри економіки, підприємництва та бізнес-адміністрування. **Пімоненко Тетяна Володимирівна**, к.е.н, старший викладач кафедри економіки, підприємництва та бізнес-адміністрування. Сумський державний університет. **Енергетичний сектор України: еколого-економічні особливості**. Стаття присвячена аналізу використанню енергетичного ресурсів в Україні. У цій статті використані українські офіційні статистичні дані. Проаналізували використання структури енергоресурсів для теплової електростанції на 2013-2017 рр. На основі результатів і методики розрахунку проаналізували обсяг викидів забруднюючих речовин в атмосферу з природного газу і вугілля.

З метою реалізації еколого-орієнтованого розвитку необхідно враховувати ефективність енергоресурсів і його екологічний ефект. Результати аналізу показали, що вугілля і природний газ є основними джерелами забруднення в Україні. Помічено, що структурна частка вугілля і природного газу коливається в сезонних коливаннях. Слід підкреслити, що поширення та впровадження відновлюваних джерел енергії дозволить збільшити обсяг виробництва енергії (безпосередньо) і зменшити обсяг забруднення навколишнього середовища (опосередковано). Таким чином, одна сонячна енергостанція потужністю 10 кВт * год виробляє 10 як 200 кВт * год / рік, вона побічно замінює традиційні енергетичні ресурси. Як ми писали вище, більша частина української енергії проводилася тепловими (використовуваними вугільними і природними газами) і ядерними (як наслідок - величезними радіаційними) електростанціями. Відзначається, що в минулому році АЕС виробила понад 50% усього видобутку енергії. Це можна пояснити зменшенням обсягу поставок природного газу і збільшенням вартості вугілля. Так, аналіз динаміки використання паливних ресурсів показав, що енергетичному сектору (виробництву та споживанню) Україні притаманні сезонні коливання. З іншої сторони, результати дослідження підтверджують висунуту гіпотезу, що найбільший еко деструктивний вплив здійснюється теплоелектростанціями при виробництві енергії з кам'яного вугілля. У зв'язку з цим необхідним є заміщення виробництв, що використовують кам'яне вугілля на більш еколого-орієнтовні ресурси, у тому числі відновлювальні джерела енергії. У цьому напрямку, зміна системи екологічного оподаткування може виступати інструментом мотивації поширення відновних джерел енергії. При цьому доцільним є врахування сезонних коливань та економічну оцінку екологічного збитку від використання традиційних джерел енергії.

Ключові слова: еколого-орієнтовний розвиток, енергетичний сектор, навколишнє середовище, паливні ресурси, відновлювальні джерела енергії.

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A. Pavlyk, assistant. **O. Lyulyov**, PhD (Economics). **O. Chyhyryn**, PhD (Economics). **T. Pimonenko**, PhD (Economics). Sumy State University. **Ukrainian energy sector: ecological and economic features**. The paper devoted to the main features of energy sector in Ukraine. Thus, the authors analysed the main energy resources which dominated in Ukraine. The results of analysing showed that the energy consumption has the season fluctuating. In addition, the findings approved that thermal power stations which used coal are the most polluters among energy companies. That is why it is necessary to reorient the energy market from the traditional resources to the renewable energy direction. In this case, changing of ecological tax system could be one of the incentive instruments to spread renewable energy. Besides, the authors proposed to include the assessment of environmental damage and season fluctuating from the using the traditional energy resources (coal, natural gas and etc.).

Keywords: ecological oriented development, energy sector, environment, fuel, renewable energy resources.

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Павлик Анатолій Володимирович, асистент. **Льовов Алексей Валентинович**, к.э.н, доцент. **Чигрин Елена Юрьевна**, к.э.н, доцент. **Пимоненко Татьяна Владимировна**, к.э.н. Сумской государственной университет. **Энергетический сектор Украины: эколого-экономические особенности**. В статье проанализировано функционирование энергетического рынка в Украине. Так, анализ динамики использования энергетических ресурсов показал, что энергетическому сектору (производству и потреблению) Украина присущи сезонные колебания. С другой стороны, результаты исследования подтверждают выдвинутую гипотезу, что наибольшее экодеструктивное влияние осуществляется теплоэлектростанциями при производстве энергии из каменного угля. В связи с этим необходимо замещение производств, использующих уголь на более эколого-ориентированные источники энергии, в том числе возобновляемые. В этом направлении, изменение системы экологического налогообложения может выступать инструментом мотивации распространения возобновляемых источников энергии. При этом необходимо учитывать сезонных колебания и экономическую оценку экологического ущерба от использования традиционных источников энергии.

Ключевые слова: эколого-ориентированное развитие, энергетический сектор, окружающая среда, топливные ресурсы, возобновляемые источники энергии.