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THE PROBLEMS OF RECOVERY AND DEVELOPMENT OF THERMAL POWER ENGINEERING AT THE CONTROLLED TERRITORIES OF DONETSK AND LUGANSK REGIONS

Despite the worldwide shift in the approaches to thermal power sector functioning and putting the stimulation of renewable and alternative sources of energy usage as the main priority of global power engineering development, thermal power plants still play the important role in electric power production.

Aspirations to diversify the ways of electric energy production and to lead energy production to the principally new level of development, are characteristic also for Ukraine. However, the structure of electric energy production remains practically unchanged. Its maximal part is related with atomic power plants (about 55%). The share of thermal power plants is also high (35%). Traditionally the most demanded energy sources in Ukraine are fossil resources: natural gas and coal, presenting together 2/3 of total energy balance of the country.

The structure of electric power production in Donetsk and Lugansk regions witnesses the orientation of energy production of these both regions on the traditional production by thermal power plants (TPP). This production depends on stable coal supplies. Taken into account the huge losses of coal industry of Ukraine due to the military conflict at the East of the country, the thermal power engineering development at the controlled territory of Donetsk and Lugansk regions requires the correct assessment of the opportunities of its recovery and of its further prospects in the conditions of changes in economic, industrial and natural potentials of Donetsk and Lugansk regions.

Considering the importance of energy sector for the economic development of the country, the problems of its reforming and efficient functioning are paid by large attention both in research and practical aspects. The All-Ukrainian energy Assembly [1] provides at the regular basis the surveys of energy sector. The experts of O. Razumkov Center have done significant research interventions, where based on complex analysis of energy sector functioning in Ukraine in 2016, the achievements and lost opportunities of each sector have been determined, taken in account the specific of Donetsk and Lugansk regions [2].

Last time the studies of energy security problems in the view of Eastern regions' involvement in hybrid war have got widespread. At the early beginning of Russian aggression the energy component of the war of a new generation have been reviewed [3]. The issues of energy sector as one of priorities of Donbas socio-economic potential's recovery have been raised [4]. The problems of destroyed/damaged potential at the uncontrolled territories recovery after control reestablishment, situation and problems of energy sector at the controlled territories of Donetsk and Lugansk regions have been studied [5]. Meanwhile, beyond the marks of research studies remains the assessment of weaknesses and opportunities of energy sector of controlled territories of Donetsk and Lugansk regions, that influence directly on the sector's recovery and prospective. Thus, the goal of the article is to determine the risks and opportunities of thermal power engineering recovery at the controlled territory of Donetsk and Lugansk regions and the prospect of its further functioning in the new economic and political conditions.

The energy production of Donetsk and Lugansk regions has been based on the usage of traditional types of thermal electric power, produced by TPPs. In each region it has been presented by the integrated complex of generating, networking and technical-maintenance industries.

In the structure of all-Ukrainian production of electric energy at TPPs and Combined heat and power plants (CHPP), electric energy production at the controlled territories of Donetsk and Lugansk regions accounted for more than one third. In 2017 the share has been reduced at the expense of loss of control over Starobishyvska, Zuivska TPPs and Zuivska CHPP, producing (data of 2015) more than 5 % on electric energy of these regions. Taken into account high energy intensity of "basic" industries of Donetsk and Lugansk regions and export orientation of electric power engineering itself, these losses are tangible for the economies of the regions and Ukraine as a whole and will affect the economic indicators (Table 1).

The majority of electric energy generating plants of Donbas (4 of 6 TPPs, Kramatorska CHPP in Donetsk region, DTEK Luganska TPP as well as Severodonetska and Lysychanska CHPPs in Lugansk region) have been remained at the territory, controlled by Ukraine.

Besides that, some industrial plants of Lugansk (CJSC "LINIK", JSC "Rubezhnoe Cardboard & Package Mill", "Research and Production Enterprise "Zarya" Ltd, State enterprise "Chemical plant "Pivdennyy") and Donetsk (JSC "Avdiivka Coke Plant", CHPP "Azovstal") regions, controlled by Ukraine, have unit-stations, producing electric energy, used by them for their own needs. Its share in total electricity, produced by each region, is not significant and does not reach over 5%.

Table 1

Electric energy production by TPP and CHPP at the controlled territories of Donetsk and Lugansk regions in 2015-2016, KWt*H mln

	2015	2016	2016 to 2015, %
TPP total in Ukraine, incl.:	**49 386,237**	**49 902,321**	**101,04**
TPP in Donetsk region	15 595,15	13 856,30	88,85
TPP in Lugansk region	2 591,058	3 338,427	128,84
JSC "Donbasenergo", incl.:	***4 288,379***	***2 991,322***	***127,1***
Starobishyvska TPP	1 934,938	-	-
Slovianska TPP	2 353,441	2 991,322	127,10
JSC "Tsentrenergo", incl.:	*8 422,152*	*9 858,364*	*117,05*
Vuhlehirska TPP	4 446,922	4 879,356	109,72
OJSC "DTEK Shidenerho", incl.:	*9 450,906*	*9 324,053*	*98,66*
Zuivska TPP	890,461	-	-
Kurakhivska TPP	5 969,387	5 985,626	100,27
Luganska TPP	2 591,058	3 338,427	128,84
CHPP total in Ukraine, incl.:	**6 075,221**	**6 709,309**	**110,44**
CHPP in Donetsk region	343,92	386,175	112,29
CHPP in Lugansk region	197,377	68,690	34,80
JSC "DTEK Donetskoblenerho"	317,485	386,175	121,64
Zuivska CHPP	26,437	-	-
Siverodonetska CHPP	197,377	68,690	34,80
Total in Ukraine	55 461,46	56 611,63	**102,07**
Total in Donetsk region	15 939,07	14 242,48	**89,36**
Total in Lugansk region	2 788,44	3 407,12	**122,19**

The main projected fuel for Donetsk and Lugansk regions electric power plants are coals of ranks "A" (anthracite) and "G" (gas coal), however all of them can operate with gas-oil fuels as reserve ones. Furthermore, controlled territories of Donetsk and Lugansk regions own a rich energy potential, that can be efficiently used in the reconstruction of TPPs, that worked with anthracite coal (Table 2). The reconstruction, scheduled by the Plan of Development of Generating Capacities at Thermal Power Plants till 2026, expands the opportunities of generating plants of Donetsk and Lugansk regions in the modern conditions [6].

Table 2

Energetic capacity of Donetsk and Lugansk regions, controlled by Ukraine

City/District	Coal		Electricity	
	Coal deposits (balance, mln tons)	Ranks of coal	TPP capacity MWt	Unit-stations capacity, MWt
Vuhledar	290,9	Gas, Gas-flame		
Pokrovsk	429,1	Coke, Fat, Gas		
Myrnohrad	220,2	Gas		
Selidove	403,7	Gas, Flame		
Dobropillja	640, 7	Gas, Gas-flame		
Svitlodarske			3600	
Myronivske			160	
Mykolaivka, Sloviansky Distr.			800	
Kurakhove, Mariinsky Distr.			1460	
Kramatorsk				28,5
Mariupol				172,0
DONETSK REGION, TOTAL	**1984,6**	**Gas-flame, Coke, Fat, Gas, Flame**	**6020**	**200,5**
Zolote	100,0	Gas-flame, Gas		
Hirske	45,4	Gas-flame, Gas		
Toshkivka	30,2	Flame, Gas-flame		
Lysychansk	179,7	Flame, Gas-flame, Gas		
Shchastja (Luganska TPP)			1360	
Severodonetsk			260	
Lysychansk				110
LUGANSK REGION, TOTAL	**355,3**	**Gas-flame, Gas, Flame**	**1620**	**110**

The state of TPPs, located at the controlled territory, differs and has been determined, first of all, by their position related to demarcation line and places of fighting. However, all TPPs operate in complicated conditions, caused by the damages of infrastructure, rupture of well-established business communications, difficulties with fuel supply due to fighting and locking coal transportation from temporarily uncontrolled territories of Donetsk and Lugansk regions since the beginning of 2017.

Vuhlehirska, Myronivska, Luganska TPP have been located at the confrontation line, thus their problems have been determined by the consequences of fighting. Primarily these are:

damages, inability/difficulty of recovery works;

damages, that cannot be recovered (DTEK Luganska TPP);

shortage of coal supply;

minimal regime of power units capacities' utilization due to logistic limitations of fuel supply;

inability to ensure safe labor conditions (violation of "silence regime", mining of "grey zone");

shortage of substations and high-tension cables.

The periodicity and efficiency of these TPPs' operation depends of conflict escalation and shortages of any types resources' supply (coal and chemicals), necessary to recover the production process at electric generating plants, damages of electric equipment, shortage of spare parts for repair and impossibility of its stable supply, as well as lack of personnel (about 70%).

Slovianska TPP has the problems, conditioned by the consequences of fighting. As actual for this TPP, are also the problems of fuel shortage, caused by locking of anthracite supplies from uncontrolled territories. Logistic limitations are minimal after rearranging of the power units on gas coal.

Restructured in 2015, DTEK Kurakhivska TPP is one of the most prospective of TPPs of Donetsk region. Based on the program of wide scale technical re-equipment of generating capacities, the latter have been increased, maneuverability range has been expanded, economic and environmental indicators have been improved. Since 2017 the technological processes should be audited for the compliance with world standards and complex energy saving program should be elaborated. In the new conditions Kurakhivska TPP has the problems getting the optimal capacity utilization level.

Starobishyvska and Zuivska TPPs have been located at the territory, not controlled by Ukraine.

To some extent the shortage of electric energy in the energy system on the regions could be compensated by the improvement of productive capacities' utilization of neighboring regions' TPPs, that mainly operate in suboptimal regimes and have been loaded by 20-25% of design conditions. This should be considered as real, as soon as other energy generating plants of Donetsk and Lugansk regions operate with coal ranges, extracted at the controlled territory, as well as gas-oil fuels, that allows some maneuvers in fuel supply.

However, even after the termination of fighting, the recovery of thermal energy engineering should be complicated by high physical deterioration and obsolescence of energy equipment, causing significant non-productive losses of fuel and energy resources (the degree of fixed assets' of the sector wear in Donetsk and Lugansk regions accounts for more than 50 %). The majority of energy facilities does not comply with European environmental standards, have severe negative impact on environment and requires modernization.

In the conditions of financial resources' shortage for TPPs reconstruction, the further exploitation of obsolete technologies will exhaust the resource of fixed assets' usage in electricity and heat generation and aggravate the problem of efficiency of its exploitation (increment of losses during the transportation of fuel and energy resources, its distribution and electric energy and heat utilization, increase of emissions of pollutants). The analysis of strengths and weaknesses of thermal power engineering recovery/development at the controlled territory of Donetsk and Lugansk regions has been integrated in Table 3.

Taken into account comparatively low cost of 1 KWt*h of electricity, generated by TPPs, the general state-level priority of TPPs modernization till 2026 creates some opportunities for thermal power engineering development during Donbas economy recovery. Furthermore, according to electric energy production forecast till 2035, electricity generation at TPP/CHPP in Ukraine will be reduced insignificantly [7].

Accounting the world trends of TPPs share reduction in electric power generation requires the analysis of opportunities for the development of alternative energy engineering in Donetsk and Lugansk regions, based on usage of non-traditional and renewable energy sources – one of basic directions of technologies' development worldwide. Integrated with informational and nanotechnologies, this could be an important component of neo-industrial model of economic development of Donbas.

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Table 3

SWOT-analysis of thermal power engineering at the territories of Donetsk and Lugansk regions, controlled by Ukraine

Strengths	Weaknesses
Location of the majority of energy generating plants of Donetsk and Lugansk regions at the territory, controlled by Ukraine; Location of main consumers of electricity, produced by TPPs (with energy intensive production), at the territory of the regions; National-level aspiration to TPPs modernization, according to European Parliament and EU Council Directive, limiting emissions of atmospheric pollutants at large combustion plants; Positive experience of TPPs modernization (Starobishyvska & Kurakhivska) compliant with the European standards of energy generating plants' operation concerning the limits of atmospheric pollutants emission; Positive experience of Kurakhivska TPP reconstruction concerning the improvement of its reliability and increase of equipment lifetime, expanding maneuverability range, reducing energy intensity; The majority of energy generating plants of Donetsk and Lugansk regions operate with the coal of ranges, extracted at the territory, controlled by Ukraine; The significant stock of explored reserves of coal at the territory of Donetsk and Lugansk regions; Adopted Plan of generating capacities' development till 2026, envisaging TPPs' modernization and reconstruction; Planned re-equipment of TPPs, ordered to transfer to the coal of gas range; Planned increase of the capacities of Vuhlehirska, Kurakhivska, Slovianska, Luganska TPPs at the expense of energy units' rearrangement for gas range coal or low-calorie coal and screened coal; Planned building of a new power unit at Slovianska TPP; Ability of all TPPs of Donetsk region and Luganska TPP, remained at the controlled territory, to operate both with coal and gas-oil fuels, that enables some maneuverability in fuel supply strategies; Opportunity to develop energy engineering using the facilities of distributed generation of low and medium capacity (unit-stations at the plants of coal, metallurgical and coke industries)	Significant physical wear and obsolescence of energy equipment, causing large non-productive losses of fuel and energy resources (the degree of wear of fixed assets of the sector in Donetsk and Lugansk regions accounts for more than 50 %); The majority of TPPs does not comply with European environmental standards and make severe negative impact on environment; Major part of existing energy facilities requires modernization; Modernization of TPPs requires large investments; Worldwide trends of TPPs' share reduction in electricity generation; Reduction of demand for energy resources, conditioned by demand decline at the international markets of products of basic sectors of Donetsk and Lugansk regions; Inefficient usage of productive capacities of TPPs (operating at the load of 20-25 % of design conditions reduces the efficiency of facilities, mechanisms, equipment, working in suboptimal regimes, the share of nonproductive unit costs increases); Weakens the development potential of the sector due to the location of 3 of 5 energy generating plants at confrontation line and one – at the stage of liquidation (SE "Lysychanska CHPP"); Reduction of coal extraction and its shortage for stable TPPs operation; Increasing problems of TPPs' supply with coal fuel due to the problems in coal industry and transport infrastructure destruction; Damages of energy facilities of TPPs, located at confrontation line; Lack of personnel of energy generating plants (about 70%) in the conditions of fighting; Shortage of spare parts for repair and impossibility of its stable supply, conditioned by fighting; complications of other resources' supply (coal and chemicals), necessary for production process recovery at energy generating plants; Significant losses during transportation, distribution and usage of electric energy and heat
Opportunities	**Threats**
Shortage of financial resources for electric energy consuming enterprises to implement energy-efficient measures, causing the conservation of high energy intensity; Comparatively low cost of 1 KWt*h of electric energy, generated by TPPs; Undeveloped alternative energy sources	Deterioration of the problems of TPPs supply with any resources due to the next escalation of armed conflict, or its expansion to new territories of the country; Shortage of financial resources for TPPs' reconstruction; Further exploitation of obsolete technologies at TPPs; Exhausting of the lifetime of fixed assets in electricity and heat generation, that can cause the reduction of efficiency and deterioration of pollutants' emission; Increase of losses during the transportation of fuel end energy resources, distribution and usage of electric energy and heat; Risks of price increases for energy resources

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Снігова О. Ю. Проблеми відновлення та розвитку теплової енергетики на підконтрольній території Донецької та Луганської областей

Здійснено оцінку представленості генеруючих підприємств теплової енергетики на підконтрольній території Донецької та Луганської областей. Оцінено спроможність та перспективи відновлення теплової енергетики в нових економічних та політичних умовах, що характеризуються втратою частини потенціалів східних областей. Виявлено слабкі сторони та обмежувачі функціонування галузі в нових умовах. Встановлено ризики (загрози), що можуть стримувати, ускладнювати або унеможливлювати її розвиток.

Ключові слова: теплова енергетика; перспективи відновлення; підконтрольні території; Донецька та Луганська області; втрата частки економічного та ресурсного потенціалу.

Снеговая Е. Ю. Проблемы восстановления и развития тепловой энергетики на подконтрольной территории Донецкой и Луганской областей

Осуществлена оценка представленности генерирующих предприятий тепловой энергетики на подконтрольных территориях Донецкой и Луганской областей. Выявлены перспективы восстановления тепловой энергетики в новых экономических и политических условиях, характеризующихся потерей части потенциалов восточных областей. Выявлены слабые стороны и ограничения функционирования отрасли в новых условиях. Установлены риски и угрозы, которые могут сдерживать или усложнять ее развитие.

Ключевые слова: тепловая энергетика; перспективы восстановления; подконтрольные территории; Донецка и Луганская область; утрата экономического и ресурсного потенциала.

Snihova O. The problems of recovery and development of thermal power engineering at the controlled territories of Donetsk and Lugansk regions

The assessment of representation of thermal power plants at the controlled territories of Donetsk and Lugansk regions has been done. The opportunities and prospects of thermal power engineering recovery has been estimated in the new economic and political conditions, characterized by the loss of a part of Eastern regions' potential. Weaknesses and limitations of the sector functioning in the new conditions have been revealed. Risks (threats) that can impede, complicate or disable its development, have been determined.

Keywords: thermal power engineering, recovery prospects, controlled territories, Donetsk and Lugansk regions, loss of a part of economic and resource potential.

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