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Article

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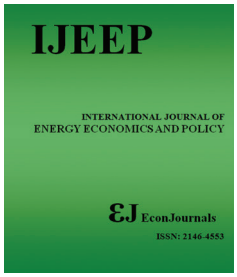

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State Policy of Kazakhstan on Implementing of Renewable Energy Sources in Textile Industry Companies

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ABSTRACT

The article discusses the mechanisms of state support for the development of renewable energy sources (RES) in the Republic of Kazakhstan. The authors consider the prospects of using solar energy in the textile industry. The analysis revealed that the level of organization of work in companies in the field of energy conservation and energy efficiency of production depends on the following factors: timely observation of the current power supply and possible future energy potential; development and implementation of energy-effective measures; use of RES with purpose of saving energy resources. According to the authors, the dominance of electric and thermal forms of energy in the cost structure leads to a loss of competitiveness of the company's products in the textile industry. The article considers the transition to combined generation of electric and thermal energy in textile industry companies using renewable energy sources. The calculation of the energy saving coefficients of electric and thermal energy produced by the authors proved the possibility of reducing the cost of textile products by introducing renewable energy sources. The results of the assessment, based on the construction of a correlation and regression model, showed the economic efficiency of using renewable energy in the textile industry, while the authors recommend paying special attention to state regulation of tariffs and the auction price for renewable energy.

Keywords: Renewable Energy Sources, Solar Energy, Textile Industry
JEL Classifications: Q42, Q48, L60

1. INTRODUCTION

In modern conditions, supporting the implementation of renewable energy sources at the early stages of development is widely recommended by government programmes. In this case, the regulatory framework should create conditions for finding and attracting investment in the construction of renewable energy generating facilities.

The development of renewable energy sources (RES) in Kazakhstan is associated with the adoption of the Law of the Republic of Kazakhstan (2009) "on support for the use of renewable energy sources," which defines the tools of state support.

The introduction of renewable energy in textile companies is driven by energy and, to a large extent, technological factors, since the latter contribute to increasing output, improving quality and reducing the cost of production while reducing energy costs. According to the Order of the Minister of investment and development of the Republic of Kazakhstan (2015), JSC "Institute for development of electric power and energy saving" provides financial, legal and technical assistance for

the introduction of renewable energy in the textile industry of Kazakhstan.

Therefore, one of the main ways to maintain competitiveness is the introduction of renewable energy in the textile industry.

Thus, the purpose of this study is to identify the potential use of RES in the textile industry and assess their impact on the structure of the company's energy expenditure. To achieve the goal, the following tasks must be accomplished:

- Review the literature on the use of renewable energy in textile companies
- Consider instruments of state support for renewable energy in Kazakhstan
- Analyze the level of use of energy resources in the textile industry of Kazakhstan
- Calculate the potential for using renewable energy sources in the textile industry
- Evaluate the economic efficiency of RES use in the textile industry.

2. LITERATURE REVIEW

The main uses of energy in textile industry lies in heating of water and drying of water, implying that a reduction in use of water would lead to a reduction in energy consumption. It costs half to produce a unit of renewable energy for use in textile industry compared to using fossil fuel energy. The savings are further increased when the efficiencies of the machines used are increased.

As the world, and specifically Europe, increase its reliance on biogas and other renewable energy sources, one industry that is benefiting significantly is the textile industry (Hasanbeigi and Price, 2012, p. 3649). Among the reasons that are prompting the shift to renewable energy sources in the industry is the concern for the environment as well as the fluctuating fossil fuel prices in the international market (Nunes et al., 2013, p. 337). Additionally, the demand for energy is growing daily, and the need for renewable energy is emphasized each day. The textile industry is one that is segmented, composed of both large scale and small-scale enterprises with different energy efficiencies (Khude, 2017, p. 1468).

A singular characterization of the industry is difficult because of the various processes undertaken in the chain and the different energy requirements of different processes. Ranging from designing fibers to dying and other processes, energy forms a significant cost in manufacturing (Yilmaz et al., 2005 p. 146). A number of researches have been done to evaluate energy efficiencies in the textile industry. The reduction of pollution and costs associated with energy consumption in the textile industry has been fundamental in the drive towards the adoption of sustainable energy (Desore and Narula, 2018, p. 1440). The competitive nature of the textile industry implies that the margins have to be high for a company to compete. The translation is that the operating cost must be reduced and productivity optimized at the same time.

The threat of global warming and climate change has been a key driver in the adoption of renewable energy sources globally, and the textile industry is no different. The process of making textiles emits dangerous fumes that, when released to the environment, cause harm to humans and the entire biodiversity (Huang et al., 2017, p. 72). The burning of fossil fuels, as well, increases the rate of greenhouse gas accumulation speeding up the process of climate change and global warming in general (Palanichamy and Babu, 2005, p. 604).

Many modern authors, defining the concept of "energy saving" and "energy efficiency improvement," along with using definitions from the current legislation, also focus on attracting renewable energy sources. For example, Sergeev (2013) indicates the following characteristics for the "energy saving" category: reducing the final specific consumption of energy resources; efficient use of non-renewable natural energy resources; attraction of renewable energy sources in domestic production. In the research of Kazakhstani scientists, the prospects of using renewable energy sources (Bolyssov, 2019), the use of solar energy (Abayev, 2018) and biogas (Tasmaganbetov, 2020) are considered as alternative energy sources.

However, scientists do not pay enough attention to the use of renewable energy sources to increase the competitiveness of the textile industry.

2.1. State Regulation of Renewable Energy Development in Kazakhstan

The Republic of Kazakhstan has a concept for the transition to a "green economy" (2013), which provides for increasing the share of RES in the total structure of electricity production to 10% by 2030.

In order to provide state support for the development of renewable energy sources, fixed tariffs have been applied since 2014 on the basis of the decree of the government of the Republic of Kazakhstan (2014) "on approval of fixed tariffs." Fixed tariffs were approved by the government of the Republic of Kazakhstan for a period of 15 years for each type of renewable energy.

This state support was used by many industrial enterprises, including textile companies, which sold their products at a high price in the form of a fixed tariff. However, the mechanism of auctions for the selection of renewable energy projects was introduced on the basis of amendments and additions to some legislative acts of the Republic of Kazakhstan on electricity. This continued until 2018 to replace the fixed tariffs (2017).

For companies in the textile industry of solar photoelectricity is considered to be the most promising. This is evidenced by changes in the actual average tariff (reduction from 28.1 tenge/kWh in 2016 to 17.5 tenge/kWh in 2019) for the introduction of photovoltaic plants in these companies (Table 1).

Data from Table 1 show that fixed solar energy tariffs were adjusted annually for inflation and changes in the exchange rate of the national currency to convertible currencies. The state annually purchasing energy at inflated prices from companies in the textile industry, using alternative sources of energy has stimulated the development of renewable energy.

The established auction price reduced the price for the supply of solar energy to 29.0 tenge/kWh in 2019. The introduction of the auction mechanism will gradually reduce the state budget expenditures allocated for the development of renewable energy sources. However, contracts concluded before 2018 at fixed rates will be valid until the end of the term. This makes it possible to compensate for part of the costs of textile companies that have implemented renewable energy technologies and will provide them with certainty in the long term.

2.2. Use of Energy Resources in the Textile Industry of Kazakhstan

Energy-saving projects are of strategic importance for textile companies, as they make a significant contribution to maintaining their competitiveness by reducing energy costs. To this end, textile companies strive not only to plan investments in improving energy infrastructure, but also to justify the amount of such investments, giving an adequate risk assessment for each project. The main prerequisites for the formation of energy-saving projects and measures are a significant share of the cost of production; Linking energy consumption to the company's other resources; systematization, on the basis of this connection, design solutions and their evaluation; requirements for energy rationing methodology based on project activities. The overall understanding of the extent of energy consumption in the textile industry companies of the Republic of Kazakhstan for the period 2017-2019 is illustrated in the Table 2.

The data in Table 2 indicate an annual decrease in the number of textile companies (164 in 2017, companies, and 157 in 2019), but there is an increase in revenue from sales of products by 16749 million tenge in 2019 compared to 2017. Significant fluctuations in revenue from sales of products are due to several factors: changes in the number and composition of operating textile companies in the country; a sharp increase in prices for the main technological raw materials – cotton and energy resources.

From 2017 to 2019, there was a noticeable decline in energy consumption by textile companies from 30% to 25%. The amount of energy costs, and, consequently, the level of energy efficiency of production, in principle, may depend on many factors, such as the state and operating modes of existing equipment, the perfection of the fabric processing technologies used, and the range of products. At the same time an important role is played by the level of organization of work in companies in the field of energy saving and energy efficiency of production:

- Investigations with purpose of indication of the current energy supply potential
- Development and implementation of effective energy saving measures
- Use of the renewable energy sources, with purpose of saving energetical resources.

Electricity and heat consumed by textile companies is consumed in technological processes. Figures 1 and 2 show the use of energy resources in the processing stages: spinning production, weaving production, and finishing production.

From the analysis of the consolidated energy balances of textile companies, it follows that the largest consumption of heat (67%) and electric (46%) energy is accounted for finishing production.

In accordance with the logic of consistently solving the problem of energy efficiency of finishing production of a textile company, it is necessary to pay attention to a number of objective reasons. These include: morally and physically outdated equipment; low activity in the field of innovation; weak communication with research organizations; lack of highly qualified personnel among workers and engineers; insufficient equipment with metering devices for energy consumption.

2.3. Potential use of Renewable Energy Sources in the Textile Industry

When using RES in the textile industry, the correct selection of energy sources is of great importance. It is necessary to consider their compatibility. In the technological processes of textile production, which are carried out on the principle of flow, continuity and mass production, the energy of the sun and biogas is effectively used to generate electricity and heat. According to "Settlement and financial center for support of renewable energy sources" LLP (2019), RES is currently a dynamically developing sector in electricity production in Kazakhstan. Electricity generation from renewable energy facilities in the textile industry of Kazakhstan is increasing every year due to a set of measures for the implementation of renewable energy development programs in the Republic of Kazakhstan. State-subsidized renewable energy projects have increased their share in textile companies up to 8% in 2019 (Table 3).

Statistical data on energy consumption in textile companies leads to the conclusion that:

Table 1: Tariffs and auction price for solar energy in Kazakhstan (tenge/kWh)

Indicators	2016	2017	2018	2019
Indexed fixed tariffs	34.61	40.35	43.21	45.84
Auction price	-	-	34.61	29.0
Average tariff in the textile industry	28.1	24.9	19.4	17.5

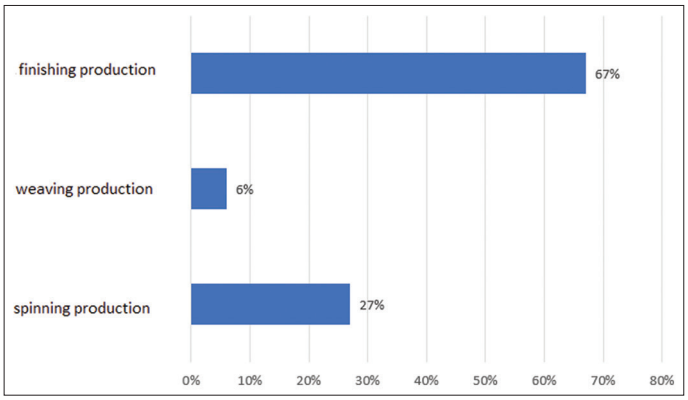
Source: Compiled by the authors based on the Calculation of indexation of fixed tariffs and indexed fixed tariffs (2019), the Order of the Minister of energy of the Republic of Kazakhstan on approval of maximum auction prices (2019) and statistical data of the Ministry of energy of the Republic of Kazakhstan (2019)

Table 2: Dynamics of energy resource consumption in the textile industry of the Republic of Kazakhstan

Year	2017	2018	2019	Changes from year 2017 to 2019
Number of companies	164	161	157	−7
Revenue from sales of products, million tenge	43489	54487	60238	+16749
Including energy costs, million tenge	13047	14712	15060	+2013
%	30	27	25	−5

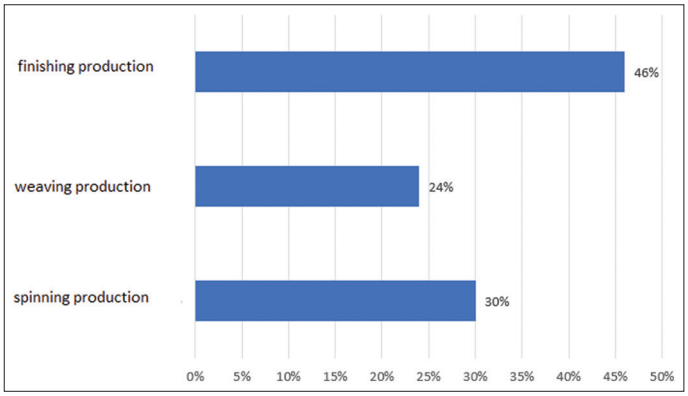
Source: compiled by the authors according to the statistics Committee of the Ministry of national economy of the Republic of Kazakhstan (2019)

Figure 1: Consumption of thermal energy for the stages of production for 2019



Source: Compiled by the authors according to the statistics Committee of the Ministry of national economy of the Republic of Kazakhstan (2019)

Figure 2: Electricity consumption by production stage for 2019



Source: Compiled by the authors according to the statistics Committee of the Ministry of national economy of the Republic of Kazakhstan (2019)

- High share of electric (53%) and thermal (39%) forms of energy
- Availability of energy-saving potential associated primarily with the introduction of renewable energy sources. As a result of the dominance of electric and thermal forms of energy, the component of the cost of production is high, which leads to a loss of competitiveness of the company's products in the textile industry.

However, the replacement of traditional fossil fuels and reduction of dependence on energy resources through the introduction of RES made it possible to make adjustments to the structure of energy expenditure in the textile industry (Table 4).

The development of renewable energy in textile companies was chosen as a priority to reduce the cost of production. Despite the fact that the share of RES in consumption is 8%, their share in the structure of energy consumption is 2%. The obtained value corresponds to the existing needs of companies in the industry, which indicates their self-sufficiency in providing cheap energy.

Table 3: Dynamics of energy consumption in textile companies (%)

Types of energy	2017	2018	2019	Changes from 2017 to 2019
Electricity	55	54	53	−2
Heat energy	43	41	39	−4
RES	2	5	8	+6
In total	100	100	100	

Source: compiled by the authors according to the statistics Committee of the Ministry of national economy of the Republic of Kazakhstan (2019) and the Ministry of energy of the Republic of Kazakhstan (2019)

The transition to combined generation of electric and thermal energy in textile companies using RES has expanded their capabilities not only in energy, but also in financial aspects.

This is evidenced by the calculations of energy efficiency indicators of textile industry companies in Kazakhstan (Table 5).

According to the results of calculations, the total amount of electricity savings amounted to 671.05 million tenge, heat energy−509.6 million tenge. Based on the data obtained, the energy efficiency indicator of the textile industry company of Kazakhstan was calculated – the energy saving coefficient of electricity (8.4%) and the energy saving coefficient of thermal energy (8.7%). Thus, the analysis of the data shows that the required reduction in energy intensity and increase in the competitiveness of textile companies by reducing the energy component of the cost of their products is possible through the introduction of renewable energy sources.

2.4. Assessment of the Economic Efficiency of RES use in the Textile Industry

The authors propose an estimation method based on the construction of a correlation and regression model, in which the effective (endogenous) factor feature is revenue from sales of products in the textile industry of the Republic of Kazakhstan (y).

As independent (exogenous) factors, the costs of renewable energy sources in the textile industry companies (x_1) and the tariff for the use of energy from renewable sources (x_2) were selected.

In general, the two-factor correlation and regression model has the following form (Gusarov, 2001, p. 201):

$$\hat{y}_{x_1x_2} = a_0 + a_1 \cdot E_1 + a_2 \cdot x_2 \quad (1)$$

To find the parameters a_0, a_1 and a_2, the following system of linear equations is used, obtained on the basis of the least squares method (Gusarov, 2001, p. 202):

$$\begin{cases} a_0 \cdot n + a_1 \cdot \sum x_1 + a_2 \cdot \sum x_2 = \sum y \\ a_0 \cdot \sum x_1 + a_1 \cdot \sum x_1^2 + a_2 \cdot \sum x_1 \cdot x_2 = \sum y \cdot x_1 \\ a_0 \cdot \sum x_2 + a_1 \cdot \sum x_1 \cdot x_2 + a_2 \cdot \sum x_2^2 = \sum y \cdot x_2 \end{cases} \quad (2)$$

To determine the reserves available in independent factor features, the elasticity coefficient is used, which shows the average change in the effective feature $\hat{y}_{x_1x_2}$ when the factor features x_i change by 1%.

Table 4: The cost structure of energy companies in the textile industry

Types of energy	2017		2018		2019		Changes from 2017 to 2019 (%)
	Million tenge	(%)	Million tenge	(%)	Million tenge	(%)	
Net costs	13047	100	14712	100	15060	100	-
Electricity	7338.9	56.25	8246.1	56.05	8388.4	55.7	−0.55
Heat energy	5675.5	43.5	6282.0	42.7	6370.4	42.3	−1.2
RES	32.6	0.25	183.9	1.25	301.2	2.0	+1.75

Source: Compiled by the authors according to the statistics Committee of the Ministry of national economy of the Republic of Kazakhstan (2019) and the Ministry of energy of the Republic of Kazakhstan (2019)

Table 5: Calculation of efficiency indicators of integration of RES in 2019

Types of energy	Energy economy, million tenge	Energy consumption, million tenge	Coefficient of energy effectiveness (%)
Electricity	671.05	7981.8	8.4
Heat energy	509.6	5873.4	8.7

Source: Compiled by the authors based on the data in Tables 2-4

Table 6: Data for calculating parameters A_0, A_1 and A_2 in the model (1)

Year	The cost of renewables, million tenge, x_1	The tariff for renewable energy, x_2	Revenue, million tenge, y	Additional calculations for the model				
				x_1^2	x_2^2	$x_1 x_2$	$y x_1$	$y x_2$
2016	25.9	28.1	20 523	670.81	789.61	727.79	531 545.7	576 696.3
2017	32.6	24.9	43 489	1 062.76	620.01	811.74	1 417 741.4	1 082 876.1
2018	183.9	19.4	54 487	33 819.21	376.36	3 567.66	10 020 159.3	1 057 047.8
2019	301.2	17.5	60 238	90 721.44	306.25	5 271.00	18 143 685.6	1 054 165.0
Total	543.6	89.9	178 737	126 274.22	2 092.23	10 378.19	30 113 132.0	3 770 785.2

In general, the coefficient of elasticity is defined as follows (Gusarov, 2001, p. 212):

$$Э_i = a_i \cdot \frac{\overline{x_i}}{\overline{y_i}} \quad (3)$$

where a_i is the regression coefficient for the factor i;

$\overline{x_i}$ – average value of the factor i;

$\overline{y_i}$ – average value of the studied indicator.

Data for determining the model (1) is presented in Table 6.

The system of linear equations (2) after substituting the values of Table 6 into it will take the following form:

$$\begin{cases} 4 \cdot a_0 + 543{,}6 \cdot a_1 + 89{,}9 \cdot 0_2 = 178\,737 \\ 543{,}6 \cdot a_0 + 126\,274{,}22 \cdot a_1 + 10\,378{,}19 \cdot 0_2 = 30\,113\,132{,}0 \\ 89{,}9 \cdot a_0 + 10\,378{,}19 \cdot a_1 + 2\,092{,}23 \cdot 0_2 = 3\,770\,785{,}2 \end{cases} \quad (4)$$

Having solved this system, we have:

$$\begin{cases} a_0 = 188\,971{,}75 \\ a_1 = -94{,}22 \\ 0_2 = -5\,850{,}19 \end{cases} \quad (5)$$

Thus, the desired model will look as following:

$$y = 188\,971{,}75 - 94{,}22 \cdot x_1 - 5\,850{,}19\, x_2 \quad (6)$$

Defining the reserves inherent in independent (exogenous) factors needs to calculate the elasticity coefficients using the formula (3).

$$Э_1 = -94{,}22 \cdot \frac{(543{,}6 / 4)}{(178\,737 / 4)} = -0{,}2866 \quad (7)$$

$$Э_2 = -5\,850{,}19 \cdot \frac{(89{,}9 / 4)}{(178\,737 / 4)} = -2{,}9425 \quad (8)$$

The authors have next conclusions:

1. The signs of the coefficients a_1 and a_2 in the model (6) correspond to the real flow of processes in economics and logic
2. With a 1% reduction in energy costs in textile companies generated from renewable energy sources, revenue from sales of products will increase by 0.2866%
3. If the tariff for the use of energy from renewable sources in the textile industry is reduced by 1%, revenue from sales of products will increase by 2.9425%.

3. CONCLUSION

Textile companies in Kazakhstan are working to improve the energy efficiency of production: identification of the existing energy saving potential; development and implementation of effective energy saving projects; use of renewable energy sources aimed at saving energy resources. Combined generation of electric and thermal energy in textile companies using renewable energy sources confirmed their compatibility in technological processes. The introduction of renewable energy sources contributed to the growth of energy saving coefficients for electricity and heat, which led to a reduction in the cost of textile products.

The assessment, based on the construction of a correlation and regression model, showed the economic efficiency of the state policy of Kazakhstan from the use of renewable energy in the textile industry. Further state policy of Kazakhstan in the field of renewable energy should be aimed at regulating the fixed tariff and auction price.

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