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ASSESSMENT OF ELECTRICITY CONSUMPTION CHARACTERISTIC: TEXTILE FACTORY CASE STUDY

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Abstract: Currently, electrical energy tariffs are a crucial factor in the electricity market, as they significantly impact the decisions made by end users. They play a vital role in the effectiveness of energy management systems (EMS). Tariffs are not solely considered a fixed component of expenditure calculations. Instead, they are indirectly linked to the costs of power generation, electricity transmission, and electricity distribution, as well as other determinants such as government taxation. In certain regions, improper tariff calculation methodologies have resulted in substantial power losses, superluous investments, increased operating costs, and environmental pollution because of the underutilization of available renewable energy sources. This study examined the electrical energy consumption values and characteristics of an integrated textile factory. Additionally, analyses were conducted on the electricity tariffs published by the Energy Market Regulatory Authority (EMRA) Electricity Energy Market management, in order to decrease the electrical energy consumption costs of the textile factory. Based on the findings of the analyses, suggestions were put forward for regulating the electrical energy consumption characteristics and reducing the electrical energy consumption costs.

Keywords: Electricity consumption, Electricity tariffs, Energy management, Energy markets

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1. Introduction

Energy management is a process application consisting of procedures for monitoring and optimizing energy consumption used in buildings. It needs to be sustainable and constantly reviewed. The main aim of energy management is to take initiatives to cost-effectively reduce the energy consumption required and to reduce the energy consumption without reducing the productivity (Zaki and Hamdy, 2022).

Electricity tariffs are guides with energy unit fees that determine the amount of bills that consumers will pay for electricity use. Electricity tariffs play an important role in the electrical enegy market, they directly affect consumers' decisions and energy usage habits (Grimm et al., 2021). They are also very important to increase competition in the electricity market. Today, local consumers can respond to bill amounts and seek different ways to reduce their energy consumption (Ren et al., 2016). In this case, revenues from electricity bills may tend to decrease. This trend will not reduce costs and will pave the way for the rest of the consumers to obtain energy at higher prices in order to meet the operating expenses. As a result, the expediency of electrical installations will disappear. It will cause problems throughout the system and increase energy costs (Felder and Athawale, 2014; Brown and Sappington, 2018). In this context, a preferable tariff design should appeal to different user profiles but be applicable at the same time. It should be able to cover energy costs without causing inequalities. This situation was frequently discussed in studies in the literature (Borenstein, 2016; Neuteleers et al., 2017). In order to accurately determine the energy costs in the electricity tariffs, factors such as the cost of electricity production, the costs of operation and maintenance that make the operation of transmission and distribution networks possible and sustainable should be taken into account (Ansarin et al., 2020; Batlle et al., 2020). Electricity pricing has a significant impact and a delicate balance on the demand-based generation and distribution of energy. As a natural consequence of this situation, considering the environmental conditions and geographical effects, it has been determined that energy costs vary between different countries or different regions within (Hinz et al., 2018; Sulaima et al., 2019). The widespread use of renewable energy sources such as wind, solar and hydroelectricity in the electricity grid has affected the electricity unit prices for residential, commercial and industrial sectors.

In recent years, many methodologies have been developed to detect current loads and develop Energy Management System (EMS) strategies (Li et al., 2019). Evaluation of generation plans to understand current energy requirements and power generation techniques were discussed. Forecasts based on load models were made using artificial neural networks (Poongavanam et al., 2023). A supporting energy management system regulating electrical energy use had been proposed (Zorita et al., 2016). This system was designed to improve the EMS of buildings. The energy performances of the facilities were analyzed comparatively. The relationship between EMS and electricity tariffs following the load profile was discussed in detail with different variations. In another study, a set of EMS methodologies were discussed in (Ouédraogo et al., 2021), and the fee advantages provided for PV and electric vehicle systems that provide electrical energy to a residential building are examined and compared from different perspectives. Calculation of the energy cost obtained and consumed provides a total profitability and thus the most suitable method was determined. In a study (Wu et al., 2022), a new method, which includes a multifunctional strategy, was proposed by adjusting the charge and discharge states of the PV system with a life cycle planning. A new EMS methodology was introduced to control pricing manipulation. The effect of the four-time energy pricing tariff on the planning of energy consumption discussed in (Zhao et al., 2023). In addition, the approach of load sharing configurations of different levels of stakeholders within the microgrid is examined in order to reduce financial costs. A predictively optimized energy procurement model was discussed, which minimizes energy costs and reveals the best energy sharing strategy for stakeholders (Qayyum et al., 2022). In another study, EMS as energy planning was carried out with reference to ISO 50001 standard, and the first step is the optimal tariff management analysis. It has been emphasized that the implemented EMS provides absolute benefits (Iscan and Arikan, 2022).

In this study, the electrical energy consumption characteristics of an integrated textile factory were examined. Analyzes were carried out to reveal the electricity energy consumption costs of the textile factory within the scope of the electricity tariffs published by the Energy Market Regulatory Authority (EMRA) Electricity Energy Market management. A remote monitoring system were installed in order to monitor the electrical energy consumption instantly and to keep the electricity consumption characteristics under control. In this context, instant monitoring and determination of hourly consumption data are provided. With the findings obtained, energy costs were reduced by changing the factory working hours.

2. Materials and Methods

In this section, detailed information about "Tariff Tables Based on Electricity Bills" published by EMRA is shared (EMRA, 2023). Activity-based tariffs approved and published by EMRA are published four times a year, in January-April-July-October. In 2022, an exceptional application was made within this process, with tax reductions in March and price changes in June and September. Then, the practice of publishing the updated tariffs in quarterly periods continued.

When the activity-based tariff tables are examined, it is seen that two different types of users are defined as transmission and distribution system users. While there is only one pricing option for transmission system users, different options are specified for distribution system users: industry, public sector, residential, agricultural activities and lighting. In addition, medium voltage and low voltage options are presented, where the voltage type of the connection point is determined.

For consumers who purchase electrical energy with a medium voltage connection; apart from the single-term tariff where only the electricity consumption value is priced, there is also the double-term tariff option that charges the demand consumption value as the power price. For the consumer tariffs where all these definitions are met, two different energy cost options are offered for the electrical energy consumption cost within the 24-hour period, as full-time and three-time. Finally, all tariff options include a fixed distribution fee. In the light of all this information; Considering the tariff published by EMRA in April 2023, the details of the unit electrical energy consumption cost for a single term, full-time tariff residential subscriber connected to the electricity grid from low voltage are presented in Table 1.

Table 1. Details of electrical energy consumption cost (EMRA, 2023)

Parameter	Amount	Amount
Consumption Cost	0.558378 TL	0.02893 $
Distribution Cost	0.778883 TL	0.04035 $
Consumption Tax	0.027919 TL	0.00144 $
Subtotal	1.365180 TL	0.07073 $
Value-added Tax	0.109214 TL	0.00565 $
Bill Amount	1.474394 TL	0.07639 $

The electricity consumption cost and distribution cost in Table 1 were taken from the relevant EMRA tariff and the electricity consumption tax was calculated by calculating 5% of the electricity consumption price. The subtotal value is calculated by summing the electricity consumption cost, distribution cost and electricity consumption tax. Value added tax is determined by calculating 8% of the subtotal value. In this context, the electricity bill amount consists of the sum of the subtotal value and the value added tax. In addition, the average value of USD/TL parity between 1-31 April was calculated as 19.3. With the help of this value, electricity consumption cost values were also shared in USD ($).

Residential subscribers with an average daily electricity consumption of more than 8 kWh are faced with electricity bills calculated with a gradual electricity tariff. For example, a residential subscriber who consumes 300 kWh of electrical energy within the billing period has to pay for the first 240 kWh of electrical energy at a unit price of 0.558378 TL/kWh, while for 60 kWh, he has to pay at a unit price of 1.208462 TL/kWh.

In the three-time electricity tariffs, the electrical energy consumption during the day is divided into three different time periods as daytime, peak and night. The electrical energy consumed between 06-17 hours is calculated as Daytime, the electrical energy consumed between 17-22 hours as Peak and the electrical energy consumed between 22-06 hours as Night. There is no gradual electricity tariff in the three-time electricity energy tariff. The distribution fee is the same for one-time and three-time tariffs.

In the Turkish electricity energy market; the change in unit electrical energy consumption price, including taxes, over the years for a single term, single-time tariff residential subscriber connected to the electricity grid from low voltage is given in Table 2.

Table 2. Change of electricity cost for residential subscriber (EMRA, 2023)

Period	Bill Amount
2021 January	0.796131 TL
2021 April	0.796131 TL
2021 July	0.915551 TL
2021 October	0.915551 TL
2022 January	1.373327 TL
2022 March	1.256943 TL
2022 June	1.445485 TL
2022 September	1.734582 TL
2022 October	1.734582 TL
2023 January	1.734582 TL
2023 April	1.474394 TL

In Table 3, for the month of April 2023, the unit price of electricity energy consumption, including all taxes, are shared for the residential, commercial, industrial, martyr families and agricultural irrigation options for distribution system users.

Table 3. Electricity costs by subscriber type (EMRA, 2023)

Subscriber Type	Bill Amount
Residential	1.474394 TL
Commercial	2.837906 TL
Industrial	3.670157 TL
Martyr Families and Veterans	0.698965 TL
Agricultural Irrigation	2.211597 TL

3. Electricity Consumption Characteristic of Textile Factory

In this section, electrical energy consumption data was analyzed in order to determine the electrical energy consumption characteristic of the factory. In the textile factory in Marmara region, 10 oil-type transformers with a power of 1600 kVA are connected to each other at 31.5 kV voltage level to form a ring grid. The analyses started with a factory-wide evaluation and were detailed on the basis of department and time.

3.1. Analysis of Electricity Consumption

In Figure 1, the electrical energy consumption values of the textile factory for the last five years are shared.

When Figure 1 is examined, it is seen that the total electrical energy consumed in 2018 is 33,707.46 MWh. In 2019, this value increased by 6.5% and reached 35,890.76 MWh hours. Due to the global corona epidemic that occurred in 2020, electrical energy consumption has tended to decrease. The total consumed electrical energy value in 2020 was recorded as 29,603.72 MWh. In 2021, with the increase in electrical energy consumption especially in the second half of the year, 31,383.52 MWh of electricity was consumed. In 2022, with the living conditions returning to normal, the factory working order was re-established and the consumption record of the last five years was broken with 37,615.24 MWh electrical energy consumption at the end of the year.

When the electrical energy consumption data of the last five years are analyzed monthly, it is seen that seasonal transitions are felt. In this context, considering that the workload is also a determining factor, it turns out that evaluating the data in general will not be consistent and determining the main factor causing electricity consumption will lead to an erroneous diagnosis. As a result, more data that are detailed should be obtained in order to determine the electrical energy consumption characteristics. Electricity consumption values monitored hourly in 2022 are arranged to meet the time periods determined in EMRA tariffs and are shared monthly in Table 4. Considering the consumption trends of the data in Table 4, daytime consumption rates are 47% in January, 46.78% in February, 47.13% in March, 47.35% in April, 47.3% in May, 47.72% in June, 46% in July, It was calculated as 46.64% in August, 46% in September, 45.77% in October, 45.7% in November and 46.1% in December. Considering that the instantaneously consumed power value does not change during the whole day, this value is known to be 45.83%. It has been determined that this critical threshold has been exceeded for nine months as of the year. In this context, it turns out that the production planning is not evaluated based on the electrical energy consumption value and cannot be controlled by receiving feedback. The consumption behavior of 2022 is shared in Figure 2 based on time periods.

When Figure 2 is evaluated, the time-dependent change of the electricity consumption trend in 2022, the daytime consumption rate is 46.425%, the peak consumption rate is 21%, and the nighttime consumption rate is 32.572%. As a result of a more detailed examination of these values, the electricity consumption character will be revealed and the basis for the efforts to reduce the electricity bill amount can be laid. In this context, it has been determined that the overall consumption of the factory becomes more intense during the daytime and peak time hours. This point will be used as a support and will play an active role in the analysis of electrical energy consumption components.

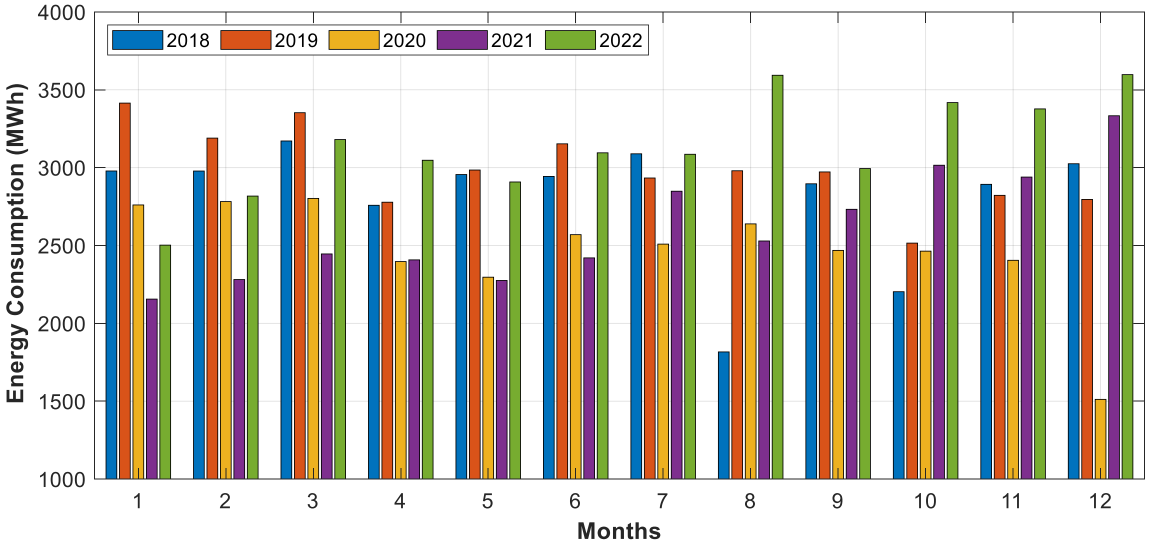

Figure 1. Electricity consumption of textile factory.

Table 4. Electricity consumption of textile factory in 2022

Month	Daytime (kWh) 06-17 [11 h]	Peak (kWh) 17-22 [5 h]	Night (kWh) 22-06 [8 h]	Total (kWh)
January	1,177,762.95	526,950.90	797,570.55	2,502,284.40
February	1,318,000.95	597,863.70	901,397.70	2,817,262.35
March	1,498,779.45	676,308.15	1,005,300.45	3,180,388.05
April	1,442,996.10	653,514.75	950,821.20	3,047,332.05
May	1,375,211.25	591,192.00	941,418.45	2,907,821.70
June	1,446,180.75	657,512.10	991,465.65	3,095,158.50
July	1,420,476.75	644,149.80	1,021,119.75	3,085,746.30
August	1,639,764.00	753,930.45	1,199,412.90	3,593,107.35
September	1,378,717.20	625,523.85	989,840.25	2,994,081.30
October	1,564,315.20	706,293.00	1,147,078.80	3,417,687.00
November	1,543,619.70	713,323.80	1,120,155.75	3,377,099.25
December	1,657,180.61	753,623.82	1,186,470.37	3,597,274.80

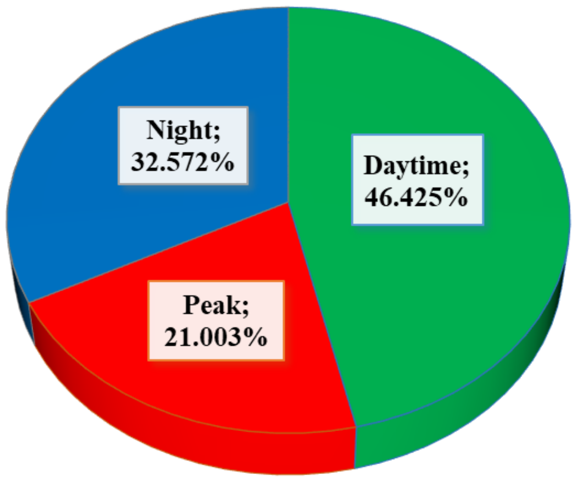

Figure 2. The consumption characteristic of factory in 2022.

3.2. Department-Based Analysis of Electricity Consumption

The factory structure consists of six different departments: spinning mill, weaving preparation, weaving-1, weaving-2, dyeing and finishing and auxiliary enterprises. While denim fabrics has been produced in the weaving-1 section, shirt and tent fabrics has been woven in the weaving-2 section. Auxiliary businesses include electrical, electronic and mechanical workshops, as well as boiler rooms and water treatment plants. Until 2022, the electricity consumption values of the factory were obtained from only electricity bills. In 2021, NEXUS 1500+ power analyzer mounting at the factory main supply point and ELNET LT energy analyzers were installed in order to monitor the electrical energy consumption of the departments within the factory. The NEXUS 1500+ power analyzer and ELNET LT series energy analyzer is shown in Figure 3.

In this study, a total of 90 energy analyzers were installed, taking into account the main production sections of the factory. The installation of the energy analyzers took approximately 6 months. Of these energy analyzers; 24 of them were established in the spinning mill department, 10 in the weaving preparation department, 12 in the weaving-1, 12 in the weaving-2, 24 in the dye finishing department and 8 in the auxiliary businesses. In this context, electrical energy consumption by the departments began to be monitored and recorded on a machine-based basis. The distribution of electricity consumption values for 2022 by departments is presented in Table 5.

When the electricity consumption data shared in Table 5 is analyzed, it can be said that factory electrical energy consumption sources in 2022 consist of four basic parts. These departments were determined as spinning mill, weaving (consisting of weaving preparation, weaving-1 and weaving-2 sections), dyeing and finishing and auxiliary businesses. In this context, 32.49% of the total electrical energy is consumed by spinning mill, 47.35% by weaving, 15.12% by dye finishing and finally 5.04% by auxiliary enterprises.

In Figure 4, the electrical energy consumption rates of all departments are shared on a monthly basis.

Figure 3. Energy analyzers used to monitor factory electricity consumption; (a) NEXUS 1500+, (b) ELNET LT series.

Table 5. Electricity consumption values for 2022 by departments

Month	Spinning Mill (kWh)	Weaving Preparation (kWh)	Weaving-1 (kWh)	Weaving-2 (kWh)	Dye-finishing (kWh)	Auxiliary Enterprises (kWh)
January	809,989.46	53,048.43	402,367.33	745,680.75	350,319.82	140,878.61
February	781,790.30	58,317.33	486,822.93	876,732.04	462,031.03	151,568.71
March	891,462.77	55,020.71	532,715.00	999,914.00	539,075.77	162,199.79
April	909,323.88	45,709.98	489,401.53	980,936.19	479,650.06	142,310.41
May	920,616.35	45,943.58	474,847.28	879,034.50	451,003.15	136,376.84
June	950,523.18	50,141.57	568,580.62	881,191.62	497,391.97	147,329.54
July	1,019,839.15	38,571.83	511,308.16	935,289.70	441,261.72	139,475.73
August	1,294,237.27	45,991.77	543,277.83	1,026,550.77	514,173.66	168,876.05
September	1,022,778.17	38,324.24	460,789.11	882,954.58	436,537.05	152,698.15
October	1,243,012.76	48,189.39	487,362.17	965,154.81	498,982.30	174,985.57
November	1,174,892.83	55,722.14	507,240.31	971,253.74	486,977.71	181,012.52
December	1,202,209.24	67,628.77	550,023.32	1,047,886.15	531,317.49	198,209.84

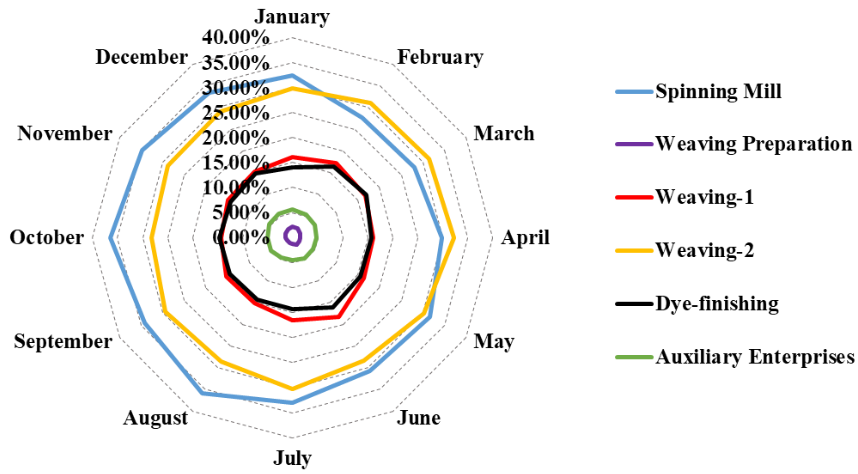

Figure 4. Electrical energy consumption rates of textile factory by departments.

Looking closely at Figure 4, it is seen that among the six different sections defined within the factory, the section where electrical energy is consumed for nine months of the year is the spinning mill. The spinning mill section is followed closely by the weaving-2 section. In fact, the weaving-2 department in February-March-April passed it. This is due to the intensive use of air conditioning devices such as compressors and air conditioners, which are used to provide the ambient conditions required by the weaving looms in the weaving-2 section. The electrical energy consumption values of the paint finishing department vary between 14% and 17% during the year according to the production planning. Although auxiliary enterprises are in the passive user class since they are not the main factor in the factory production processes, they generally constitute 5% of the factory electrical energy consumption value. Seasonal conditions have little effect on this situation.

3.3 Time-Based Analysis of Electricity Consumption

In this section, in the light of the electrical energy consumption values of December 2022, the consumption values of the textile factory sections are classified according to time and evaluated in detail within the time periods specified in the electricity tariffs determined by EMRA. In this context, the assessment of the electricity consumption values of factory departments over time is the main factor in determining the electricity consumption characteristic of the textile factory. The electrical energy consumption values for December 2022 are given in Table 6.

Table 6. Electricity consumption of textile factory in December 2022 by departments

Department	Daytime (kWh) 06-17	Peak (kWh) 17-22	Night (kWh) 22-06	Total (kWh)
Spinning Mill	549,770.28	249,939.30	402,499.65	1,202,209.24
Weaving Preparation	32,123.66	13,775.98	21,729.12	67,628.77
Weaving-1	256,640.88	116,219.93	177,162.51	550,023.32
Weaving-2	484,437.77	219,636.94	343,811.45	1,047,886.15
Dye-finishing	241,802.59	112,586.18	176,928.72	531,317.49
Auxiliary Enterprises	92,405.43	41,465.50	64,338.91	198,209.84

When the data in Table 6 were analyzed, it is revealed that the electrical energy consumed by the spinning mill section was 45.73% during the daytime, 20.79% at the peak time and 33.48% during the night time. These rates were respectively 46.8%, 20.82% and 32.38% for weaving sections. In the dye finishing section, the rates of 45.51%, 21.19% and 33.30% were obtained.

In Figure 5, the time-dependent consumption rates of electricity consumption for December 2022 are shared.

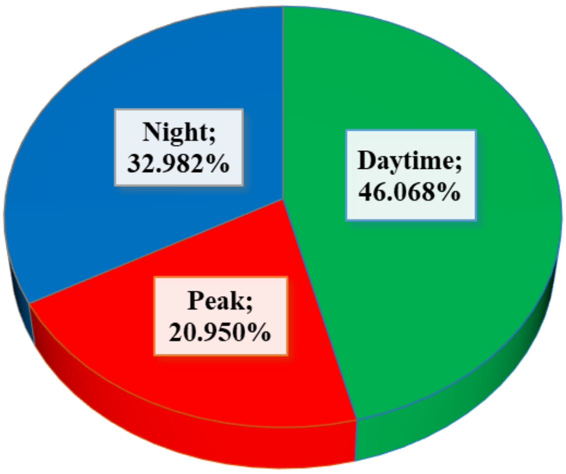

Figure 5. The consumption behavior of factory in December 2022.

When the electrical energy consumption values of the textile factory are analyzed based on time, it has been determined that all departments are the main factor in determining the electricity consumption characteristic. In this context, it is necessary to review the working order throughout the factory in order to control electricity consumption. Assessment of these factors is discussed in detail in the next section.

4. Discussion

According to EMRA tariffs, the electrical energy consumed during the day is measured between 06-17 hours, the electrical energy consumed during the peak time is between 17-22 hours and the electricity consumed at night is measured between 22-06 hours. In this context, the day time zone is 11 hours, the peak time zone is 5 hours and the night time zone is 8 hours. If the instant electricity consumption of the textile factory remained constant throughout the day, the daytime electricity consumption rate would be 45.833%, the rate of peak electricity consumption would be 20.833% and the nighttime electricity consumption rate would be 33.333%. However, when the electrical energy consumption values in December 2022 are analyzed, it is seen that the daytime, peak and nighttime electricity consumption rates are 46.068%, 20.95% and 32.982%, respectively.

This is the main factor affecting electricity energy costs. In order to analyze the factor directly, it would be a more accurate form of analysis to discuss the electricity consumption cost rather than the electricity bill amount. The effect of 2022 electrical energy consumption on electricity consumption characteristics and energy costs is given in Table 7.

Table 7. Energy costs based on monthly electricity consumption characteristics in 2022

Month	Consumption Cost (TL/kWh)	Daytime	Peak	Night	Energy Cost (TL/kWh)
January	2.456997	47.068%	21.059%	31.874%	2.417368
February	2.456997	46.783%	21.221%	31.996%	2.418358
March	2.456997	47.126%	21.265%	31.609%	2.423825
April	2.456997	47.353%	21.445%	31.202%	2.431667
May	2.456997	47.294%	20.331%	32.375%	2.399936
June	2.456997	46.724%	21.243%	32.033%	2.418231
July	2.456997	46.033%	20.875%	33.092%	2.399412
August	2.456997	45.636%	20.983%	33.381%	2.397473
September	2.456997	46.048%	20.892%	33.060%	2.400066
October	2.456997	45.771%	20.666%	33.563%	2.390335
November	2.456997	45.708%	21.122%	33.169%	2.402254
December	2.456997	46.068%	20.950%	32.982%	2.401918

Table 8. Energy costs based on department of textile factory in December 2022

Department	Consumption Cost (TL/kWh)	Daytime	Peak	Night	Energy Cost (TL/kWh)
Spinning Mill	2.456997	45.730%	20.790%	33.480%	2.393277
Weaving Preparation	2.456997	47.500%	20.370%	32.130%	2.403583
Weaving-1	2.456997	46.660%	21.130%	32.210%	2.414287
Weaving-2	2.456997	46.230%	20.960%	32.810%	2.404217
Dye-finishing	2.456997	45.510%	21.190%	33.300%	2.401670
Auxiliary Enterprises	2.456997	46.620%	20.920%	32.460%	2.407949

The electricity consumption cost in Table 7 is taken from the activity-based electricity tariffs table published by EMRA in April 2023. Calculations were made using the electricity consumption costs of the double-term tariff, which includes the power cost for the industrial type user connected from the medium voltage connection point, which is already in the electricity bills of the textile factory. Here, the electricity price stated as 2.456997 TL/kWh is valid for the all-day. In this context, electricity consumption costs are 2.489192 TL/kWh for daytime, 4.028333 TL/kWh for peak and 1.246951 TL/kWh for nighttime. The electrical energy cost of the factory was determined by using the electricity consumption characteristics of the factory and the electricity consumption costs.

Considering the data in Table 7, it is seen that the energy costs are cheaper than the one-time electricity consumption cost. A direct assessment of this information is misleading. The main reason for this is that the energy cost of an industrial enterprise that consumes constant power throughout the day has been calculated as 2.395766 TL/kWh. This should be the critical threshold value to be taken as a basis when making the comparison. From this point of view, it is striking that the electrical energy costs of the textile factory are quite variable. The energy costs obtained in July and August in 2022 are very close to each other. However, energy costs below the critical threshold value were achieved in October 2022. In Table 8, the electricity consumption values and energy cost analyzes of the factory departments for December 2022 are shared.

As can be seen in Table 8, the section with the lowest electricity consumption cost is the spinning mill section. For this reason, production planning has been reviewed in departments with high costs. When this situation is evaluated, the production planning in the weaving-1 and dye finishing departments, which work intensively at the peak time, has been reviewed and the working hours have been rearranged. The first priority of this arrangement is to be able to apply constant power consumption throughout the day. When the determined target is achieved, business plans for reducing the electrical energy consumed in peak time will be discussed. Assuming that an average of 3,100,000 kWh/month electrical energy is consumed in 2022, the effect of the 2 kr decrease in the electrical energy cost will emerge as a savings of approximately one million liras in the annual total electricity consumption cost. This value will increase even more with the taxes in the electricity bill calculation.

5. Conclusion

In this study, the electrical energy consumption characteristics of an integrated textile factory were examined by examining the electrical energy consumption characteristics. Analyzes were carried out to reveal the electricity energy consumption costs of the textile factory within the scope of the electricity tariffs published by the Energy Market Regulatory Authority (EMRA) Electricity Energy Market management.

In this context, the results can be listed as follows;

- It has been determined that the use of single-term tariff is misleading when evaluating the electricity consumption characteristics of a factory.
- In the evaluation of the electricity consumption characteristic, it should be assumed that the

instantaneous power consumption is constant and the unit electricity consumption price determined under these conditions should be accepted as the main criterion.

- According to the 2023 April tariffs, the critical threshold value has been determined as 2.395766 TL/kWh.
- 83.333% of the departments in the factory produce with energy costs above the critical threshold.
- The department that consumed the most electrical energy in the factory in 2022 was the spinning mill with a rate of 32.489%.
- The energy cost of the electricity consumption characteristic of spinning mill was determined as 2.393277 TL/kWh.
- Weaving-1 department has the most costly electricity consumption characteristic throughout the factory.
- It has been observed that the electrical energy cost of the Weaving-1 department is 2.414287 TL/kWh.
- The only departments within the factory where electricity consumption characteristics cannot be interfered with are auxiliary enterprises.

In future studies, it is planned to evaluate the electrical energy quality of the textile factory by using the data obtained from the energy measurement and monitoring system.

Author Contributions

The percentage of the author contributions is presented below. The author reviewed and approved the final version of the manuscript.

	C.Ç.U.
C	100
D	100
S	100
DCP	100
DAI	100
L	100
W	100
CR	100
SR	100
PM	100
FA	100

C=Concept, D= design, S= supervision, DCP= data collection and/or processing, DAI= data analysis and/or interpretation, L= literature search, W= writing, CR= critical review, SR= submission and revision, PM= project management, FA= funding acquisition.

Conflict of Interest

The author declared that there is no conflict of interest.

Ethical Consideration

Ethics committee approval was not required for this study because of there was no study on animals or humans.

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