

# Sustainability and environmental costs in the textile industry: a case study

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## ABSTRACT – REZUMAT

### Sustainability and environmental costs in the textile industry: a case study

*The impact of greenhouse gas and carbon emissions on climate change and more frequent natural disasters in recent years have increased people's and government's environmental awareness. The enactment of environmental legislation and new standards have resulted in some additional environmental costs for companies. Every additional cost is very important for companies operating under intense competitive pressure. Companies operating in the textile sector undertake the costs of prevention, use and damage at every stage of their production. In this study, the importance of the textile sector in Türkiye in terms of the country's economy has been revealed and the environmental costs of textile enterprises have been examined. The study aims to reveal the environmental costs for yarn production, yarn dyeing process, weaving-confection processes and dyeing-finishing processes separately and to calculate the share of these costs in total operating expenses. According to the results of the study, it has been determined that the share of environmental costs in total expenses in the textile company is 3.1%. It has been observed that the share of environmental costs in total expenses varies between 0.5% and 6% at different production stages.*

**Keywords:** environmental costs, textile industry, environmental accounting, sustainability, cost analysis

### Sustenabilitatea și costurile de mediu în industria textilă: un studiu de caz

*Impactul gazelor cu efect de seră și al emisiilor de carbon asupra schimbărilor climatice și a dezastrelor naturale mai frecvente din ultimii ani au sporit gradul de conștientizare al populației și al guvernelor în materie de mediu. Adoptarea legislației de mediu și introducerea de noi standarde au dus la unele costuri de mediu suplimentare pentru companii. Pentru companiile care operează sub presiune competitivă intensă, fiecare cost suplimentar este foarte important. Companiile care operează în sectorul textil își asumă costurile de prevenire, utilizare și deteriorare în fiecare etapă a producției lor. În acest studiu a fost prezentată importanța sectorului textil din Turcia în economia țării și au fost examinate costurile de mediu în întreprinderile textile. Scopul studiului este de a prezenta separat costurile de mediu pentru producția de fire, procesul de vopsire a firului, procesele de țesere-asamblare și procesele de vopsire-finisare și de a calcula ponderea acestor costuri în cheltuielile totale de exploatare. Conform rezultatelor studiului, s-a stabilit că ponderea costurilor de mediu în totalul cheltuielilor în întreprinderile textile este de 3,1%. S-a observat că ponderea costurilor de mediu în totalul cheltuielilor variază între 0,5% și 6% în diferite etape de producție.*

**Cuvinte-cheie:** costuri de mediu, industria textilă, răspundere față de mediu, sustenabilitate, analiza costurilor

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## INTRODUCTION

The Turkish textile industry has been successfully fulfilling its role as the locomotive of the country's development for many years, with the employment it provides and its high export potential. With its 3.4% share in global textile exports, Türkiye is among the top five textile exporting countries in the world. Türkiye's textile exports in 2021 are around 13 billion dollars. By the end of 2021, Türkiye will be the world's fourth-largest knitted fabric supplier, fourth-largest home textile supplier, fourth-largest denim fabric supplier, fifth-largest yarn supplier and fifth-largest woven fabric supplier. By 2022, Türkiye will be the EU's second-largest supplier of textiles and raw materials. The EU imports 15.2% of its total textiles and raw materials from Türkiye. Türkiye is the EU's

first-largest knitted fabric supplier, second-largest woven fabric supplier, and third-largest apparel and apparel supplier [1].

In addition to its role in job creation, the textile industry also causes worldwide pollution. Industrial estimates show that more than 35% of the chemicals released in the environment are the result of various textile processing and dyeing processes, and the consumption of freshwater by the textile industry is approximately three trillion gallons worldwide and is used to produce 60 billion kilograms of fabric [2]. Problems in transportation and packaging, especially harmful chemicals used in the textile industry, high water consumption and related water pollution, high energy consumption in production processes and associated air emissions, and waste generation are

the biggest obstacles to environmental sustainability [3].

A non-profit “Textile Stock Exchange” was established in 2002 to increase sustainability in the textile value chain all over the world. In 2012, the concept of “Global Recycling Standard”, which covers the recycling of waste, emerged. In addition, starting from the 1990s, it has been carrying out sustainability activities in many global textile markets such as Patagonia, Levi’s, H&M, Nike, Adidas and Esprit [3].

Sustainability activities are a current field that is discussed in the literature and is the subject of many studies in different sectors. There are also important studies on sustainability in the textile industry. Haque et al. (2021), Hayat et al. (2020), Abbas et al. (2020), Shahi et al. (2021), and Tebaldi et al. (2022) examined sustainability activities in the textile sector in different countries in their study [4–8]. However, there are not enough studies in the literature that include a detailed analysis of environmental costs for the textile industry. In this study, sustainability and environmental costs, which are the subject of current discussions, were examined specifically for textile enterprises.

The study aimed to determine the environmental costs of different enterprises of a textile company operating in Türkiye. In this regard, firstly the issue of sustainability in the textile sector was discussed and then environmental costs were explained conceptually. In the last section, environmental costs for yarn, yarn dyeing, weaving-apparel and dyeing-finishing enterprises are analysed in detail.

## SUSTAINABILITY IN THE TEXTILE INDUSTRY

Mankind has to produce to survive. With the development of globalization and industry, production has increased, this has affected all living things in the ecosystem and has led to the rapid depletion of natural resources. The increasing world population, scarce resources, and therefore the threat to future generations’ lives have pushed scientists to seek solutions. The concept of sustainability emerged as a response to these problems [9, 10].

There are many definitions of sustainability. The definition by the World Commission on Environment and Development is “development that meets the needs of the present without compromising the ability of future generations to meet their own needs” [11]. In another definition, sustainability is to limit the use of non-renewable resources by the present generation and to keep the negative effects on the ecosystem at a level that does not exceed the capacity of the system to transfer the diversity and non-renewable resources in its ecosystem to future generations [3]. Sustainability, which is necessarily one of the main problems of the twenty-first century, is generally handled together with corporate social responsibility, informed purchasing decisions and the green orientation that has emerged in some companies [12].

Sustainability has three dimensions:

**Ecological (environmental) dimension of sustainability:** Environmental sustainability is to ensure the continuity of natural resources and to transfer them to future generations, to use non-toxic and recyclable resources that do not harm the physical environment. In the ecology dimension, sustainability is examined in two stages:

- Production ecology; selection of textile raw materials, chemicals and processes with an environmentally friendly approach, use of treatment methods at every necessary stage;
- Waste ecology; It is the conversion or recycling of wastes such as water and textile products, which occur after production, into products that are harmless to the environment.

**Economic (labour force) dimension of sustainability:** In the economic dimension, sustainability is the protection of life and the environment and ensuring economic growth. The question to be asked in terms of economy is how development can be achieved without compromising the ability of future generations to meet their own needs. Ensuring economic sustainability in the textile sector is possible by using raw materials, energy and manpower in production processes without wasting them.

**Social (equality) dimension of sustainability:** In the social dimension of sustainable development, it is aimed to increase education and health standards, maintain cultural diversity, respect human rights and reach living standards in which basic human rights are implemented [13, 14]. Creating a working environment based on the fundamental rights and health of the workforce in the textile industry is the first important step to be taken for social sustainability. In addition, production processes, products and designs that increase the living standards of the whole society and prioritize their health contribute to social sustainability.

## Recycling

To ensure sustainability, enterprises need to reintroduce the waste they cause in their activities to the economy.

Recycling in the textile industry is the reuse or reprocessing of used clothes, fibrous materials and textile waste from the production process. Recycling textile waste is not only an important way to solve many environmental problems but also a tool of socio-economic and environmental sustainability [15].

Countries are increasingly focusing on commercial waste and producer responsibility to meet increasing recycling, reuse, and prevention targets. Directive 2008/98/EC in Europe; defines the basic concepts and definitions related to waste management such as waste definitions, recycling and recovery. It explains when waste ceases to be waste and becomes a secondary raw material and how to distinguish between waste and by-products. The regulation reveals some basic waste management principles, such as waste must be managed without endangering human health and harming the environment, especially without endangering water, air, soil, plants or animals, without

causing disturbance through noise or odours, and without adversely affecting rural areas or areas of special interest.

Waste legislation and policy of EU Member States implement the “waste management hierarchy”. Accordingly, the priority of waste is to prevent and reduce the amount of waste at the production stage. Secondly, efforts should be made to recover waste through reuse, recycling and energy production. As a last resort, the waste is destroyed or stored safely without harming the environment. In other words, first of all, the aim should be to prevent waste, if it cannot be prevented, it should be reused or recycled, and if neither can be done, waste should be destroyed [16].

### **Carbon footprint**

Carbon footprint has become a widely used term and concept in public debates about responsibility and mitigation action against the global climate change threat. A carbon footprint is a measure of the specific total amount of carbon dioxide emissions that result directly or indirectly from an activity or accumulate over the life stages of a product [17].

Although the impact of sustainable textile production on global warming has not come to the fore until today, the output of atmospheric pollutants is also high due to the wide scope and supply chain of the sector and the production. For example, although a fabric does not seem to pollute the environment, most of the production processes result in greenhouse gas emissions, CO<sub>2</sub> and methane (CH<sub>4</sub>) gases, etc., and negative environmental effects bring along the sustainability problem in the textile industry. To reduce the carbon footprint against the global climate change threat, the use of renewable energy sources can be preferred instead of obtaining energy from fossil fuels in production. In addition, the reuse of expired fabrics as raw materials, regular maintenance of the machines used in the enterprise, insulating hot water tanks and the use of energy-saving lighting elements will contribute to the reduction of carbon footprint. In recent years, when zero waste management has gained importance, sustainability in production can be achieved by targeting a “zero carbon footprint” in the textile industry [18].

Corporate Sustainability is the adaptation of economic, environmental and social factors to company activities and decision mechanisms, together with corporate governance principles, and the management of risks that may arise from these issues, to create long-term value in companies. Borsa Istanbul, where publicly traded companies in Türkiye are dealt with, has a sustainability index along with many different indices. The purpose of the BIST Sustainability Index is to create an index that will include companies that are traded on Borsa Istanbul and have a high level of corporate sustainability performance and to increase understanding, knowledge and practices on sustainability in Türkiye and especially among Borsa İstanbul companies. Companies that

want to be included in this index must meet the environmental, corporate governance and social criteria determined by Borsa Istanbul. Environmental criteria include companies' environmental policy, environmental management systems, biodiversity policy and climate change management. As of 2023, there are 73 companies in the BIST Sustainability Index, and only one of these companies, Kordsa Teknik Tekstil Anonim Şirketi, operates in the textile sector [19].

### **ENVIRONMENTAL LEGISLATION AND ENVIRONMENTAL STANDARDS**

The rapid industrialization in Türkiye in the last twenty years has led to an increase in environmental problems and legal and institutional arrangements on the environment. The highest legal norm that determines the limits of rights and requirements on the environment is the 1982 Constitution. The third article of the Environmental Law No. 2872 enacted in 1983 contains general principles regarding the protection, improvement and prevention of pollution of the environment. The Environmental Impact Assessment Regulation (EIA), one of the most important and effective instruments of environmental law, which was first issued in 1993 and was last updated in 2019, emerges as an important process in which environmental activities are supervised and coordinated in the process from the start of a project to its completion. EIA is a tool used by the upper decision mechanisms to prevent and reduce all the positive and negative effects that may be experienced in the future, starting from the implementation phase of the project, and to make decisions appropriate for the environment, before the implementation decision is made for a planned project [20].

In addition to the environmental law and EIA regulation, textile enterprises operating in Türkiye have to consider the EU council proposal of 17 June 1992 on the textile and clothing industry and the council directive 96/61/EC on textile production issued on 24 September 1996.

### **Environmental management systems**

Setting standards to prevent environmental problems is an important environmental policy tool used by the state to prevent and control environmental problems. It is aimed to minimize the damage to the environment by determining the limited amounts of pollution and dangerous dimensions of environmental factors such as air, water, soil and noise. The most important ones among such standards are ISO 14001 Environmental Management System Standard, BS 7750 Environmental Management System Standard and Eco-Management and Audit System (EMAS) standards. The ISO 14001 Standard, which is the most accepted among these standards, was developed by the International Standards Organization (ISO) and published in August 1996. ISO14001 is the only audited and certified standard of the ISO 14000 Series. In addition to these standards, OEKO-TEX Standard 100 is an international and independent

certification system. OEKO-TEX Standard 100 also provides significant advantages for manufacturing and exporting textile companies. Textile companies that have the OEKO-TEX Standard 100 certificate thus eliminate international trade barriers, increase the export and import share of textile products, and make an important contribution to the environment and vitality by ensuring environmentally friendly and human health-friendly production [21].

Considering human and environmental health, it is seen that the production and use of organic textile products have increased in recent years. The most well-known of the standards certifying that textile products are organic is the Global Organic Textile Standard (GOTS). According to GOTS criteria, fibres, yarns, fabrics, accessories, chemicals, dyestuffs, etc. that may harm human and environmental health cannot be used in the production of organic textile products [22]. For this reason, GOTS certification has an important place in the textile industry in terms of environmental and human health.

### Environmental costs

Environmental costs include the costs of interventions that a business takes to prevent, reduce or repair environmental damage caused by its activities. Environmental costs can be grouped into three main groups: reduction costs, usage costs and loss costs. Reduction costs; These are the costs incurred by enterprises to protect the environment, prevent environmental problems, and minimize the damage to the environment. Usage costs; It covers expenses arising from the use of environmental natural resources. Accordingly, it is necessary to determine the costs of wear, abrasion, etc. resulting from the use of environmental resources. Loss costs are; It consists of the costs that the environmental pollution or environmental damage caused by the activities of the enterprises will impose on the enterprises [23]. Loss costs are included in the costs of penalties and compensation for complaints and lawsuits filed as a result of air, water, soil, and noise pollution. Reduction, use and loss costs for enterprises can be counted as follows:

- Reduction (Prevention) Costs: process control, environmental planning, emission measurement, recycling designs, environmental reports, environmental audit etc.
- Usage Costs: air, water, soil costs, noise costs, energy costs etc.
- Loss Costs: penalties and compensations, environmental clean-up, waste disposal, etc.

### MATERIAL METHOD

This study focuses on explaining the analysis of environmental costs in textile companies. In the analysis part of the study, a company operating in the textile sector in the Denizli province of Türkiye was examined. This company has yarn, yarn dyeing, weaving-apparel and dyeing-finishing enterprises located in four different locations. Environmental costs in these enterprises were determined on a unit basis and their share in the general expenses of the company was calculated. The data were obtained through face-to-face interviews with company officials and examining the annual financial statements for 2022. Financial reports were examined using the content analysis method All costs are determined annually and calculated in Euros.

### RESULTS AND DISCUSSION

In this section, first of all, the results of the analysis of the environmental costs of four different enterprises belonging to the textile company are shown separately. Then, the total environmental costs of the company were calculated by summing the costs of all enterprises.

The results of the four enterprises owned by the company are presented below.

**a) Yarn Enterprise:** Yarn production is carried out by opening and embossing the fibre, cleaning, blending, combing and separating the short fibres and neps into slivers, drawing them to the desired yarn count, and twisting. Environmental costs in yarn production processes generally consist of energy management costs and waste management costs.

The environmental costs of the yarn enterprise are shown in table 1. When table 1 is examined, it is seen

Table 1

ENVIRONMENTAL COSTS OF THE YARN ENTERPRISE	
Costs	Annual amounts (€)
<b>Prevention costs</b>	<b>20,219</b>
Fee paid to educators for Environmental education	708
Equipment used by workers (mask etc.)	9,100
Additional overtime fees paid to workers for training	10,000
Led bulb project for electricity saving (Economic life 5 years)	2,054 / 5 year = 411
<b>Loss costs</b>	<b>3,875</b>
Waste disposal cost	3,875
<b>Total environmental costs (annual)</b>	<b>24,094</b>
<b>Total enterprise expenses</b>	<b>4,500,000</b>
Share of environmental costs in total expenses	<b>0.54%</b>

ENVIRONMENTAL COSTS OF YARN DYEING ENTERPRISE	
Costs	Annual amounts (€)
<b>Prevention costs</b>	<b>2,080</b>
Environmental engineer consulting fee	820
Oeko-Tex certification fee	1,055
Chimney filtering system cost (maintenance + filter)	205
<b>Usage costs</b>	<b>14,602</b>
Wastewater cost	14,500
Natural gas boiler maintenance cost	102
<b>Recycling recovery</b>	<b>2,286</b>
Sales of waste	2,286
<b>Total environmental costs (Prevention costs + Usage costs – Recycling recovery)</b>	<b>14,396</b>
<b>Total enterprise expenses</b>	<b>1,278,315</b>
Share of environmental costs in total expenses	<b>1.13%</b>

that environmental costs, prevention costs and damage costs are realized in the yarn enterprise, but it is determined that there are no usage costs. During the interview with the enterprise manager, it was stated that the protective equipment was used for the occupational health and safety of the employees. In addition, environmental training was provided to the employees outside of working hours and overtime wages were paid to the workers. At the same time, old type bulbs have been replaced with LED bulbs to save electricity. Another striking point is that the enterprise cannot gain from recycling and waste, on the contrary, it bears costs for their disposal.

As can be seen in table 1, the share of environmental costs in total expenses in yarn enterprise is approximately 0.5%, which is quite low.

**b) Yarn Dyeing Enterprise:** When coloured yarn is used in weaving and knitting enterprises, raw yarns are dyed according to the desired colour and properties in yarn dyeing enterprises. Yarn dyeing enterprises are one of the enterprises where most chemicals are used in the textile sector.

Environmental costs of yarn dyeing enterprise are shown in table 2. When table 2 is examined, in the yarn dyeing enterprise, it was observed that the environmental costs, prevention costs and usage costs were realized, and it was determined that there were no damage costs. As prevention costs, the business incurred environmental engineering consultancy fees, certification fees and chimney filtering costs. In addition, there are wastewater costs and natural gas boiler maintenance costs as usage costs. It has been observed that recycling is achieved through the sale of waste.

As can be seen in table 2, the share of environmental costs in total expenses in the yarn dyeing enterprise is approximately 1% and is quite low.

**c) Weaving-Apparel Enterprise:** Since weaving and apparel are located in the same building and some cost items are combined in the integrated company

where we work, environmental cost calculations are also combined. It is the enterprise where the fabrics are woven and the apparel processes are carried out according to the desired specifications.

The environmental costs of the Weaving-Apparel enterprise are shown in table 3. When table 3 is examined, in the weaving and apparel enterprise, it was observed that the environmental costs, prevention costs and usage costs were realized, and it was determined that there were no damage costs. Prevention costs include equipment costs, depreciation costs, water treatment expenses and training costs. It has been observed that recycling gains are obtained by the sale of waste.

As can be seen in table 3, the share of environmental costs in total expenses in the weaving-apparel enterprise is approximately 6% and is higher than other enterprises. This is due to the newly installed solar energy system in the enterprise.

**d) Dyeing Finishing Enterprise:** These are the enterprises where the fabrics are dyed according to the desired properties. One of the departments where chemicals are used the most is dyeing finishing enterprises.

The environmental costs of the dyeing finishing enterprises are shown in table 4. When table 4 is examined, in the dyeing finishing enterprise, it has been observed that environmental costs, prevention costs, usage costs, and damage costs are realized. Prevention costs include inspection, certification, filtering and training fees. It has been observed that recycling is achieved through the sale of waste.

As seen in table 4, the share of environmental costs in total expenses in the dyeing finishing enterprises is approximately 2%.

In table 5, the total environmental costs of the company are shown in terms of cost types. These costs are calculated by bringing together the environmental costs of four different enterprises (yarn, yarn dyeing, weaving-apparel and dyeing-finishing enterprises).

Table 3

ENVIRONMENTAL COSTS OF THE YARN ENTERPRISE	
Costs	Annual amounts (€)
<b>Prevention costs</b>	<b>79,572</b>
Equipment used by workers	16,000
Ventilation-air conditioning system (annual depreciation fee)	57,000
Water treatment expense	5,510
Fees paid for Environmental education	1,062
<b>Usage costs</b>	<b>340,000</b>
Solar energy system (annual depreciation fee)	340,000
<b>Recycling recovery</b>	<b>26,728</b>
Sales of waste (textile waste + electrical waste)	26,728
Total environmental costs (Prevention costs + Usage costs – Recycling recovery)	<b>392,844</b>
<b>Total enterprise expenses</b>	<b>6,129,179</b>
<b>Share of environmental costs in total expenses</b>	<b>6.4%</b>

Table 4

ENVIRONMENTAL COSTS OF THE DYEING FINISHING ENTERPRISE	
Costs	Annual amounts (€)
<b>Prevention costs</b>	<b>45,766</b>
Ministry of Environment inspection fees	1,800
Chimney filtering cost	3,000
Oeko-Tex certification fee	8,500
Fees paid for Environmental education	1,800
Equipment used by workers	12,000
Heat recovery project – equipment – well costs (annual depreciation cost)	18,666
<b>Cost of using</b>	<b>94,200</b>
Wastewater cost	91,200
Ventilation-air conditioning system (annual depreciation fee)	3,000
<b>Loss costs</b>	<b>7,100</b>
Emission measurement cost	3,500
Chimney ash disposal cost	3,600
<b>Recycling recovery</b>	<b>2,500</b>
Sales of waste (textile waste + electrical waste)	2,500
<b>Total environmental costs (Prevention costs + Usage costs – Recycling recovery)</b>	<b>144,566</b>
<b>Total enterprise expenses</b>	<b>6,692,870</b>
<b>Share of environmental costs in total expenses</b>	<b>2.16%</b>

Table 5

TOTAL ENVIRONMENTAL COSTS OF THE TEXTILE COMPANY	
Costs	Annual amounts (€)
Prevention costs	147,637
Cost of using	448,802
Loss costs	10,975
Recycling recovery	(31,514)
<b>Total environmental costs (Prevention costs + Usage costs – Recycling recovery)</b>	<b>575,900</b>
<b>Total company expenses</b>	<b>18,600,364</b>
<b>Share of environmental costs in total expenses</b>	<b>3.1%</b>

As can be seen in table 5, the share of environmental costs in total operating expenses is 3.1%. Usage costs take the biggest share among environmental costs. The lowest cost is loss costs. The company should focus on reducing overall environmental costs by increasing the required recycling recovery.

## CONCLUSION

The textile sector, which is an important sector of the Turkish economy, provides significant contributions to the sector and the country's economy with its production and export potential. Due to its production structure, the sector creates air, water, soil, and noise pollution. Enterprises operating in the sector bear environmental costs to protect the environment through corporate social responsibility and legal regulations. In addition, the increase in people's environmental awareness has led to more preference for enterprises that produce organic products and produce by environmental regulations and environmental standards.

Environmental laws introduced for sustainable economic growth have brought additional costs to enterprises along with new responsibilities. In an increasingly competitive environment, enterprises need to carefully review all their costs to survive. In this context, enterprises have to determine the environmental costs and calculate their share of the total expenses. Contributing to the business, especially in making managerial decisions and reusing the waste generated after production, increases the importance of environmental finances. The environmental costs in the Turkish textile industry consist of the training fees spent for environmental education, the equipment fees used by the workers, the environmental management certification and inspection systems fees, the chimney filtering system costs, the wastewater cost, the boiler maintenance costs, the ventilation-air conditioning system costs. Recycling gains are also obtained by the sale of waste. In this study, the analysis of the environmental costs of textile companies

operating in Denizli province was made. As a result of the application, it has been revealed what the environmental costs consist of and it has been determined that the share of the total operating expenses is between 0.5% and 6% at different production stages.

Although the textile sector is an important sector for economies, it causes environmental pollution all over the world. The chemicals used in the industry negatively affect the entire environment, especially air and water. Additionally, water consumption used in production significantly reduces clean water resources. In this sector, which produces clothes, accessories, and home textile products from the essential needs of people; raw materials and auxiliary materials are of natural origin; reducing pesticides (chemical pesticides, pesticides) used in fibre production or choosing fibres with the least pesticide need; reducing the use of chemicals considerably, including recycling products in production, providing longer product life, enabling recycling in the production-consumption stages, and even establishing a production system that does not cause any waste generation is important for our world both ecologically and economically [13]. The use of natural fibres for human health in the textile sector and the increase of organic production lines will also contribute to the protection of the environment. Recycling of wastes to the economy by recycling will prevent loss costs and create new resources for the enterprise. Besides, the use of sustainability-based ecological materials and designs while determining the production policies of companies is effective in reducing environmental costs.

In addition to minimizing these environmental costs in the production process, taking measures to transform the waste generated after the use of textile products in a way that causes the least damage to the environment is another important point in terms of sustainability.

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