



# Analysis of the use of biomass as an energy alternative for the Portuguese textile dyeing industry



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## ABSTRACT

The energy efficiency and the development of environmentally correct policies are current topics, especially when applied to the industrial sector with the objective of increasing the competitiveness of the enterprises. Portuguese textile dyeing sector, being a major consumer sector of primary energy, needs to adopt measures to improve its competitiveness. Biomass appears to be a viable and preferred alternative energy source for the sector, while simultaneously develops an entire forest industry devoted to the supply of forest solid fuels. This work carries out a comprehensive PEST (political, economic, social and technological) analysis, which analyses Political, Economic, Social and Technological aspects of the replacement of the fossil fuels traditionally used in this sector by biomass, providing a framework of environmental factors that influence the strategic management of the companies. The main advantages are the reduction of external dependence on imported fuel due to the use of an endogenous renewable resource, the creation and preservation of jobs, the increased competitiveness of the sector by reducing energy costs, the use of national technology and the reduction of greenhouse gases emissions.

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## 1. Introduction

The intensity with which modern society develops, providing increasing levels of comfort to the people, inevitably leads to an increase in energy consumption in all its forms and shapes, requiring a constant and permanent supply.

This demand mainly for fossil fuels, traditionally more available and also cheaper, caused a gradual but effective climb in market prices, making it a key factor for competitiveness between countries, since companies competitiveness depends on the energy cost. This factor directly interferes with the balance of external transactions, giving advantages to countries or industry sectors that were able to bridge the differential production cost with sustainability measures, using alternative energy sources, improvements and modernization in production processes and measures of energy efficiency control [1–4].

In addition to the direct energy consumption costs, the costs associated with environmental damage related to fossil fuels consumption are also under the spotlight, mainly those related to

greenhouse gases emissions released into the atmosphere through the combustion of these fuels, especially CO<sub>2</sub> and SO<sub>2</sub>, as the most recognized by the public, but the list extends to other, equally or more harmful to the environment and the health of populations than the aforementioned [5].

The industry is, on a global scale, the main energy-consuming sector in all its forms, especially electricity and thermal energy for the simple operation of production lines, or for direct use in production processes, requiring a careful analysis of consumption and perception production processes, so can be found alternatives that mitigate energy costs [6,7].

The textile industry, one of the most important sectors of the economy worldwide, and for being one of the activities that benefited most from the Industrial Revolution, came over the past two centuries undergoing profound changes, accompanying the rhythm of the technological innovations that have occurred over the years, triggered by the reaction to new situations and adversities [8].

Because it is a complex industry and consists of different technical areas within their different production processes, this work aims to focus exclusively in textile dyeing, which is a major consumer of energy, especially thermal energy, once is directly used in the production process.

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The textile industry has, in Portugal, a place of prominence in the economy and businesses, with over 150 years of large-scale productive activity, and in some periods of the country's recent history has been the main employer sector, and also the most important to foreign trade balance [9].

The textile dyeing, being a key part of the finishing sector, is assumed as an area of increasing development, in which the difference by the quality of the final product bring gains from the economic point of view, justifying for its own an individual analysis of the sector [10].

It is possible to find in the literature some recent studies that address issues related to measures for the improvement of production processes in this sector, and also other studies that analyse energy efficiency actions [8], or that characterize the point of view of consumption [11]. However, there were no studies reflecting on the implications of the replacement of traditional forms of energy used in the sector of textile dyeing by new forms, especially by biomass [12].

Thus, the aim of this work is to provide a PEST (political, economic, social and technological) analysis, making a characterization of the process of replacing fossil fuels by biomass in the Portuguese textile dyeing industry, addressing all aspects of political, economic, social and technological developments that are implicit and associated with this process.

This study, after this introductory note which makes the characterization of the industrial sector and energy consumption of Portuguese textile dyeing industry, as well as an approach to environmental aspects involved, is followed by a PEST analysis, which analyses political, economic, social and technological developments related to the use of biomass as a sustainable energy alternative, and the conclusion, which summarizes the obtained results.

## 2. Characterization of the Portuguese textile dyeing industry

### 2.1. The textile industrial sector

The textile industry is a fragmented and heterogeneous sector dominated mainly by small and medium enterprises, divided by the three main uses: clothing, home textiles and industrial use [13].

This sector represents in the European Union [8]:

- 3.4% of the production of the manufacturing industry;
- 3.8% of economic value added;
- 6.9% of industrial employment.

The activities of the textile industry are distributed throughout Europe, but are more concentrated in some EU countries. Italy is the main European producer, far ahead of Germany, UK, France and Spain. These five countries account for over 80% of textile companies in the European Union, which in 2000 reached a turnover of € 198 billion, employing about 2.2 million people [14]. In Portugal, the location of textile enterprises occurs mainly in the north of the country [15,16].

The textile and clothing chain is composed of a large number of sub-sectors that encompass the entire production cycle, from production of raw materials (synthetic or natural fibres), semi-processed materials (yarn, woven and knitted fabrics) and final consumer products (textiles clothing and industrial use) [17].

### 2.2. The energetic situation in the sector

In terms of energy, the textile industry in 2009, representing about 6.25% of the total energy consumed in the manufacturing industries of Portugal, which accounted for 20.4% of final energy

consumption in the country [18]. The textile industry is traditionally an industry with intensive energy expenditures. In general in the textile industry, energy is used especially in the form of [19]:

- Electricity: for machinery, lighting, office equipment and others.
- Liquid or gaseous fuels: Naphtha, propane or natural gas for thermal power equipment.

The textile manufacturing sectors with the highest weight in energy consumption are the finishing and dyeing, when compared with other sectors. The thermal component is much greater than the electrical component in these sectors, and the implementation of thermal energy conservation measures becomes imperative [20]. In fact, Portugal starts to notice a decrease in total energy consumption (coal, oil, electricity, natural gas) since 2000 [21]. Note that this reduction is certainly linked to decrease in production, but also the energy rationalization measures taken by the industry in an attempt to reduce costs and comply with approved plans for energy rationalization [22].

The costs of electricity and especially oil have increased markedly in recent years, so the energy conservation has become a key issue. Before the energy issue has become relevant energy losses by the discharges of hot water, leaks and improper maintenance, lack of insulation on pipes and machinery, non-recovery of gas and hot air and improper settings of high-energy consumption were common occurrences in the textile industry [23,24]. These losses were generally neglected due to the pressures arising from the production and delivery times. Rising energy costs have made these occurrences unsustainable, both in terms of profitability (since the cost of energy plays a crucial role in the overall processing cost, which can go up to 30%), and in terms of the corresponding environmental concern [25,26].

In 2009, the form of energy used by most Portuguese textile industry was the natural gas needed to fuel the boilers that produce steam for sectors with higher thermal requirements, such as dry cleaning and dyeing and where natural gas replaced almost completely naphtha, minimizing maintenance costs for boilers, besides being a more “cleaner” energy [27].

### 2.3. The Portuguese textile dyeing industry

The Portuguese textile dyeing industry is a sector of fundamental importance to the national economic outlook, with a number of large companies, mainly concentrated in the municipalities of Guimarães, Vizela, Santo Tirso, Famalicão and Barcelos, in the north of Portugal in the Ave and Cávado valleys. This industrial sector represents 9% of Portuguese exports, 20% of the employment in manufacturing industries and 8% of the total production in manufacturing industries in Portugal [28].

This sector went through a period of decline, which led to the closure of many industrial units, some large, even within the European panorama, and also the realignment and reconditioning of many other companies, who have been forced to drastically reduce its number of employees in order to maintain their activity during the most intense period of international crisis which still lives [29].

Many of these companies followed, however, the path of modernization with the introduction of effective requalification programmes of its production processes and implementing action plans for energy efficiency, which allowed leverage on the quality of products and significantly increased production, contributing at the same time to the reduction of production costs, thus increasing the competitiveness of the companies [30].

This sector currently, and result of the reindustrialization actions carried out in recent years, reached the limit of cost reduction

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