Current status and analysis of the solution of Greening in the textile industry in Vietnam

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***Abstract*—Textile and garment production is one of the essential industries contributing to creating jobs for millions of workers and providing Vietnam's leading source of GDP revenue. The production process of the textile industry also has many impacts on the economy, society, and the environment, not only in Vietnam but also in most countries around the world. In the textile and Garment industry, freshwater consumption accounts for nearly 4%, and water pollution accounts for about 20% worldwide. According to the Vietnam Textile and Apparel Association, the energy consumption of textiles accounts for up to 8% of the energy consumption compared with the energy of the entire industry. It emits about 5 million tons of CO_2 per year. Therefore, solutions to green the textile industry, such as designing and building factories in a green and sustainable direction, lighting solutions, optimal production process systems, using energy-saving equipment, and alternative forms of renewable energy are some of the leading critical factors to reducing energy consumption would be analyzed, evaluated and provided optimal solutions for the goal of greening in the textile industry and progress towards the target of net zero emissions by 2050.**

Keywords—Greening, textile industry, green standard, Vietnam

I. INTRODUCTION

Vietnam has emerged as a significant player in the global textile and garment industry, but rapid industrialization has led to environmental degradation and social challenges. Recognizing the importance of sustainable development, Vietnam launches a Green Factory Initiative to promote eco-friendly practices in the textile and garment sector.

Textiles and garments have always been among the export industries with Vietnam's highest turnover and growth rate in recent years. With an average export growth rate fluctuating from 4.5% to 18% since 2012, and according to the strategic development goals for 2021 to 2030, the average speed is about 7.2 to 7.7%/year. Compared to total export turnover, the average textile and garment export rate is about 12-15% compared to the country's total export turnover [1], [2].

According to the Prime Minister's approval Decision No. 1643/QD-TTg approving "Vietnam textile, garment and footwear industry development strategy to 2030, and vision to 2035" [2], it can be seen that greening the textile industry is the top goal, developing the textile industry associated with Protecting the ecological environment, fulfilling social responsibility obligations, and ensuring compliance with sustainable development goals and international commitments.

Since 2010, many studies have addressed this issue following the trend of greening the textile industry. it is necessary to consider the life cycle of green textiles [3], [4]. Products from raw materials to design, production, and logistics must consider green and sustainable factors.

Green Manufacturing's "reduce, reuse, recycle" strategy from the 3R to 5R approach: "repair, reuse, refurbish, rebuild and recycle," addresses the importance of green manufacturing and its applications for a sustainable environment [5]. Greening activities will bring lower cost benefits and boost economic outcomes [6]. Technological innovations such as smart textiles, sustainable materials, nanotechnology, 3D printing, advanced dyeing techniques, shape memory fabrics, and biodegradable electronics are also analyzed [7]. And various green technologies to reduce environmental pollution in industries. Production aims at sustainability with technological changes, energy saving, reduced production costs, reduced waste [8], [9],[10]. As well as studies on the impact of greening on finance and investment and its impact on carbon emissions and corporate performance [11].

A study on assessing sustainability practices in the Ghana garment industry using the Triple Bottom Line (TBL) concept in large-scale garment companies to ensure compliance with sustainability practices, standards, and certifications [12].

The latest research worldwide focuses on trends and gaps in sustainability in the textile, apparel, and fashion industries, as well as green manufacturing to minimize negative environmental impacts, such as wastewater and carbon emissions, caused by traditional textile manufacturing processes [13], [14].

Particularly for Vietnam, there have been many studies on greening in the textile and garment industry. evaluating Vietnam's Textile and Garment Production Industry from a sustainable perspective concluded that with current economic, social, and environmental performance, Vietnam's textile and apparel manufacturing industry is not sustainable [15]. The energy consumption in the textile industry in Vietnam and proposed some solutions to reduce energy consumption and use energy effectively and economically [16]. Accordingly, with Prime Minister Pham Minh Chinh's commitment at COP26, Vietnam will aim to reduce greenhouse gas emissions, committing to net zero carbon by 2050. From there,

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accompanying the government, all Vietnam's industries are innovating, ensuring the economic and sustainability of businesses to promote the export of Vietnamese textiles and garments to the world, and primarily to ensure the stability and sustainability of the earth, through preserving, enhancing, and protecting the environment.

So, what policies and solutions are textile and garment enterprises facing and implementing? This article will analyze the current status of greening the textile industry and optimal solutions in the Vietnamese market.

II. THE CURRENT STATUS OF GREENING IN TEXTILE INDUSTRY IN VIETNAM

A. The Current status of the textile industry in Vietnam

The textile industry is Vietnam's key industry. The textile industry has the most significant export turnover (15%), with a reasonably high growth rate from 1.7% to 2.5% between 2005 and 2015. In 2019, export value reached 39 billion USD; in 2023, it reached 40 billion USD and is expected to reach 44 billion USD in 2024, with more than 2.5 million workers serving in the textile and garment manufacturing industry (accounting for more than 20% of the nation's industrial workforce).

Specifically, textile and garment export turnover in 2023 will reach 40.3 billion USD, going down 9.2% compared to 2022, as shown in Table 1. Of which, garment exports decreased by 3.1 billion USD (equivalent to 8.9%), fabric exports reduced by 186 million USD (equivalent to 6.9%), fiber exports also dropped by 485 million USD (equivalent to 10.3%), and exports of raw materials decreased by 218 million USD (equivalent to 16%). And in 2024, intend to get 44 billion USD [17].

TABLE 1. VIETNAM'S TEXTILE AND GARMENT EXPORT TURNOVER FOR THE LAST 5 YEARS

Years	2019	2020	2021	2022	2023	2024
Mil USD	39	35.29	40.3	44	40.3	44

It can be seen that the large decline of Vietnam's textile and garment industry in 2023 is due to the slow post-COVID recovery and due to trade barriers such as rules of origin in the Vietnam - EU Free Trade Agreement (EVFTA), exported goods must comply with strict regulations of export markets such as the European market [18]:

- The Eco-design for Sustainable Products Regulation
- Regulations on carbon border adjustment mechanism (CBAM)
- European Green Deal
- Farm-to-fork strategy
- Regulation on deforestation-free products (EUDR) into the EU market
- Regulations on the Nordic Swan ecolabel

In addition, the Committee's proposals relate to the textile strategy.

- The 'green claims directive'
- A legislative proposal on reducing the unintentional release of microplastics in the environment will include measures also on microplastics in textiles (planned for the 2nd quarter of 2023);
- A revision of the Textile Labelling Regulation (planned for the 4th quarter of 2024)
- A revision of the EU Ecolabel criteria for textiles and footwear in 2024
- A revision of the Regulation on the registration, evaluation, authorization, and restriction of chemicals (REACH) would address the presence of hazardous substances used in textiles
- The revision of the Waste Shipment Regulation will address shipments of problematic waste outside of EU

To avoid returns for not meeting green standards, businesses must ensure that their production processes comply with international sustainability and environmental regulations and standards.

B. The current status of Greening in the textile industry in Vietnam

In 2023, Vietnamese textiles and garments exported to the world market will be returned because they do not meet green standards. Specific reasons may include:

- Use of unsustainable materials: If production uses materials that are not sustainably harvested or produced, such as non-organic cotton or the use of toxic chemicals, the goods may not meet green standards and may be returned.
- Negative environmental impact: If the manufacturing process causes adverse ecological effects, such as water, air, or forest pollution, the product may not be accepted in the international market according to green standards.
- Violation of labor safety regulations: If the production process does not ensure safe and fair working conditions or violates rules on labor rights, the product may be rejected.
- Non-compliance with international environmental and social standards: Regulations on human rights, social justice, and environmental protection are becoming increasingly important in the global market. It may be returned if the product does not comply with these standards.

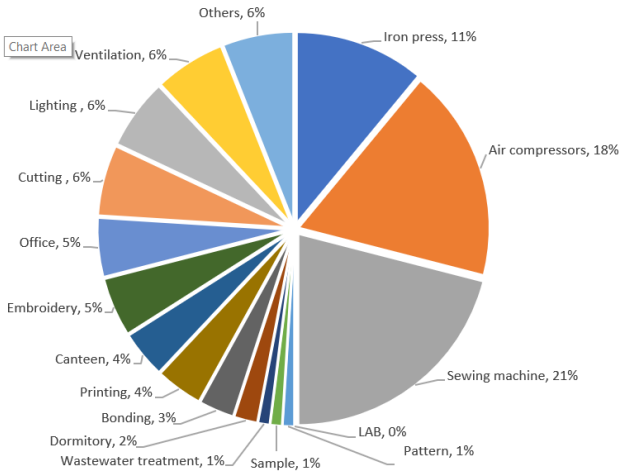


Fig. 1. Electricity consumption at a typical sportswear factory [19]

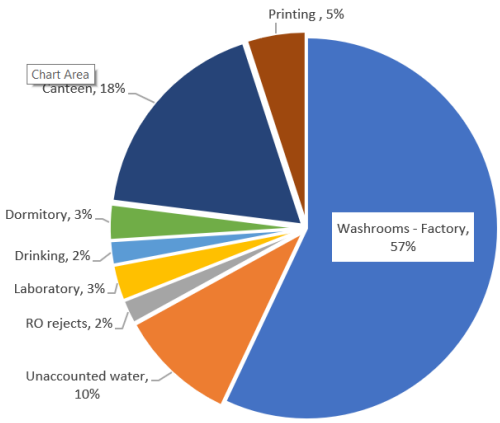


Fig. 2. Water consumption at a typical sportswear factory [19]

It can be seen in Fig.1 that the energy consumption of a garment factory is mainly for machinery equipment such as sewing machines and air compressors, lighting, ventilation, and ironing systems, accounting for from 6% to 21%. Fig 2 presented that water consumption mainly comes from washroom factories at 57%, canteens at 18%, and unaccounted water consumption at 10%.

In Vietnam, the textile industry spends about 3 billion USD annually on energy consumption. It accounts for about 8% of the energy demand of the entire sector, emitting about 5 million tons of CO_2 per year. Globally, textile manufacturing and cotton farming use approximately 93 billion cubic meters of water (4% of the world's freshwater). 20% of industrial water pollution comes from dyeing and textile treatments. It uses a lot of energy to operate machinery, heat and cool it, and produce heat and steam during material processing. Emissions totaled 3.3 Gt CO_2 equivalent.

TABLE 2. VIETNAM'S TEXTILES AND GARMENTS HAVE HAD THE GREEN CERTIFICATES FROM 2020 TO NOW

Year	PROJECT NAME	City	TYPE	GFA (m2)	Green certificate
2020	Regent Garment Factory - Phase 1 Block 10	Hai Duong	Garment	23,680	EDGE Certified
	Duy Trung Garment factory - 29/03 Corporation	Quang Nam	Garment	4,300	LOTUS Silver
	Wendler Interlining Vietnam Factory	Quang Nam	Garment	13,520	LEED Gold
	Nghi Loc Garment Factory	Nghe An	Garment	11,220	LEED Gold
2021	ECCO Shoes Factory Bau Bang	Binh Duong	Shoes	19,830	LEED Gold
2022	Paiho - Weaving factory	HCMC	Textile	6,005	LEED Silver
	Paiho - Spinning Factory	HCMC	Textile	4,144	LEED Gold
	HappyTex Textile Factory	Tay Ninh	Textile	17,150	LEED Silver
2023	Celebrity Fashion Vina Limited	Quang Nam	Textile	19,490	LEED Platinum
	Spectre Garment Technologies An Giang	An Giang	Garment	17,140	LEED Gold
	Fashion Garments Co. Ltd - p5	Quang Nam	Garment	12,132	LEED Platinum

With the trend of green and sustainable development as well as required trade barriers, Vietnamese textile and garment enterprises are forced to change and innovate within the company from the factory to the production line system, export, and production management to the entire system to meet export markets and standards according to global regulations.

According to IFC statistics, in the past 4 years, the number of industrial projects achieving Green Building Certification was 49, of which 11 were in the textile industry, accounting for 22.45%, as shown in Table 2.

Only 11 projects in the textile industry have achieved LEED, LOTUS, and EDGE certifications; a modest number of thousands of companies are participating in this field. It can be seen that awareness of the greening issue in the textile and garment industry is still limited; businesses have not yet made the transition and access to current green standards, which leads to the use of energy and water usage in the factory is not effective machinery and equipment operate with low efficiency and factory construction materials are not sustainable. It could be the reason for increasingly severe factors affecting the environment in Vietnam and the world. Increased production costs lead to poor competitiveness and exported products that do not meet the standards of demanding markets.

III. THE SOLUTION OF GREENING IN THE TEXTILE INDUSTRY IN VIETNAM

Creating a green factory in the textile and garment industry involves implementing sustainable practices throughout production. Here's a solution framework:

- Energy Efficiency: Invest in energy-efficient machinery and lighting systems. Implement energy management systems to monitor and optimize energy usage. Incorporate renewable energy sources such as solar panels to reduce reliance on fossil fuels.
- Water Conservation: Install water recycling and treatment systems to minimize water usage and pollution. Implement rainwater harvesting and greywater reuse systems. Optimize processes to reduce water waste and implement water-efficient technologies.

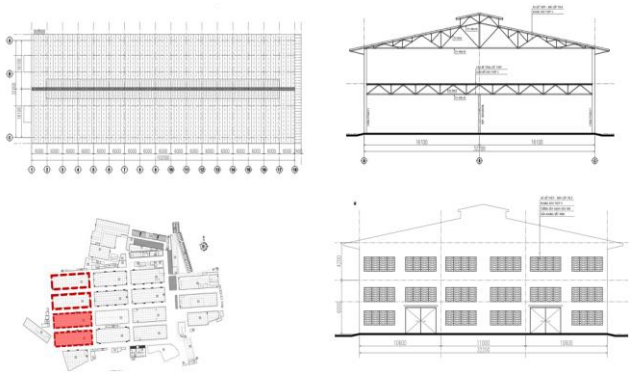


Fig. 3. Structure of a factory (authors' sources)

- Sustainable Materials: Source sustainable materials such as organic cotton, recycled polyester, and eco-friendly dyes. Implement supply chain transparency to ensure ethical sourcing practices. Encourage the use of environmentally friendly alternatives to harmful chemicals.
- Waste Reduction and Recycling: Implement waste management systems to segregate, recycle, and

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properly dispose of waste. Reduce waste generation through process optimization and lean manufacturing principles. Explore innovative ways to upcycle or repurpose textile waste.

- Worker Welfare: Ensure safe and healthy working conditions for employees. Provide training and education on environmental sustainability and occupational health and safety. Implement fair labor practices and promote worker empowerment and engagement.
- Certifications and Standards: Obtain certifications such as LEED (Leadership in Energy and Environmental Design), LOTUS, GREENMARK, and EDGE (Excellence In Design For Greater Efficiencies) …to demonstrate compliance with environmental standards. Adhere to international labor standards such as Fair Trade and ethical production practices.
- Community Engagement: Engage with local communities to address social and environmental concerns. Support community development initiatives and contribute to local environmental conservation efforts. Foster partnerships with NGOs and government agencies to promote sustainable development.
- Continuous Improvement: Establish a culture of continuous improvement by regularly monitoring performance metrics and conducting audits. Encourage innovation and collaboration among employees to identify and implement further sustainability initiatives.

By adopting these solutions, textile and garment factories can significantly reduce their environmental footprint, enhance worker well-being, and contribute to a more sustainable future for the industry and the planet.

IV. Case Study

A. The Case Study of the Green Factory in Vietnam



Fig. 4. Nghi Loc Garment Factory – LEED GOLD [20]

According to the United States Green Building Council (USGBC) [20], the Nghi Loc Garment Factory with an 11,220m^2 Ground floor area got the LEED v4 BD+C NC Gold certification on 12/08/2020, which indicates that this factory successfully met the requirements for obtaining a Gold-level certification under the LEED (Leadership in Energy and Environmental Design) rating system.

A project must accumulate several points across various credit categories to achieve LEED Gold certification. With a score of 60/110, reaching the LEED Gold level, energy and atmosphere reached 26/33 points, Indoor environmental quality reached 3/16 points, Sustainable sites reached 8/10 points, and water efficiency reached 11/11 points. It can be seen that the project focuses on solving problems of energy and atmosphere, water efficiency, and sustainable sites; the project does not yet pay attention to indoor environmental quality, innovation and design, location and transportation, and materials and resources.

B. The case study of the green factory in Bangladesh

It can be seen that Bangladesh's textile and garment industry has developed significantly in recent years, leading the world in textile and garment export turnover. One example of a company in Bangladesh with a green textile factory is "Pacific Jeans Limited" [20] [21]. This company is known for its sustainable practices and commitment to environmental responsibility in the textile industry. Pacific Jeans Limited has implemented various initiatives to reduce its ecological footprint and promote sustainability, including:

- Energy-efficient production: invested in energy-efficient machinery and technology to optimize energy consumption during manufacturing.
- Water conservation: implemented water recycling and reuse systems to minimize water usage and reduce wastewater discharge.
- Renewable energy: Solar panels were installed on its factory rooftops to generate renewable energy and reduce reliance on grid electricity.
- Sustainable materials: uses eco-friendly and sustainable materials in its production processes, including organic cotton and recycled fibers.
- Waste management: has robust waste management systems to minimize waste generation and maximize recycling and reuse of materials.
- Worker welfare: prioritizes the health and safety of its workers and provides a safe and healthy working environment.



Fig. 5. Pacific Jeans Limited LEED Platinum [21]

- Certifications: Various certifications were obtained for its sustainability efforts, including LEED Platinum certification for its green factory building.

From 2018, this company got a 50% reduction in energy consumption, a 70% reduction in groundwater use, a 65% CO_2 reduction, and sustainability goals to be achieved by 2030 (The base year 2018) with 100% solid waste recycling, 100% use of ZDHC complaints chemical, 80% use of recycled water, 50% use of renewable energy and 60% sustainable sourcing.

Pacific Jeans Limited is an exemplary company in Bangladesh's textile industry, demonstrating how sustainable practices can be integrated into textile manufacturing processes to minimize environmental impact and promote a greener future.

V. Conclusion

Throughout the analyzing and assessing the current status of the textile and garment industry and the current status of the greening of this industry in Vietnam, it can be seen that to promote and widely apply green standard models in the near future, there needs to be synchronous solutions on policy aspects as well as technical factors. Building and completing sets of evaluation criteria and standard systems for factory design is extremely necessary and plays an important role when participating in this process to meet the requirements of the export markets, especially strict markets such as the European, which aim to promote the development of Vietnam's textile and garment industry.

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