Research on the Green Transformation Path of China's Textile and Apparel Trade Based on Product Structure

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Abstract: Under the dual constraints of the global Carbon Border Adjustment Mechanism, the European Green Deal, and China's domestic"dual carbon"strategy, as China's largest light industrial export category,textiles and apparel are increasingly plagued by the high carbon emissions, high pollution, and high resource consumption caused by an extensive product structure. This paper uses the HS codes (Textile Raw Materials and Textile Articles, Chapters 50-63) as the classification basis to clarify the hierarchical structure of China's textile and apparel export products. Based on Life Cycle Assessment (LCA), it identifies the environmental load differences across all product categories, distinguishing between general green transformation products and urgently transformable high-environmental-load products. From four dimensions-supply structure, value chain, market policy, and circular system-it constructs a product-structure-optimization-oriented green transformation path, providing empirical support for foreign trade enterprises, industry associations, and the government to formulate differentiated green upgrade plans.

Keywords: Textiles and Apparel; Product Structure; Green Trade; Carbon Transition

1. Introduction

The global sustainable development agenda is driving the comprehensive implementation of green trade rules. The EU Carbon Border Adjustment Mechanism (CBAM) officially entered its implementation phase on January 1, 2026. REACH regulations continue to intensify chemical controls. The digital passport for textiles under the Ecodesign for Sustainable Products Regulation (ESPR) is expected to be phased in between 2026 and 2027, incorporating product carbon footprint, chemical control, and circular attributes into import/export thresholds. Textiles and apparel have become a key sector subject to global green trade regulations.

China's textile and apparel exports have remained in the range of US$280-330 billion in recent years (China Customs data) and are a core pillar industry for stabilizing foreign trade and employment. However, the product structure has long been characterized by a dominance of "low-end chemical fiber raw materials, primary printed and dyed fabrics, and fast-fashion garments". Virgin polyester, conventional cotton printed and dyed products, and low-price disposable clothing involve extremely high embodied carbon emissions. Under the pressure of European carbon tariffs, environmentally motivated returns, and brand ESG procurement restrictions, these products face increasingly severe trade headwinds.

Domestically, the 15th Five-Year Development Guidance for the Textile Industry clearly sets goals for industrial greening, high-end development, and circular transformation, requiring optimization of export product categories, an increase in the share of green fibers, and a reduction in water consumption and carbon emissions per unit product. The Ministry of Industry and Information Technology's Implementation Plan for the Quality and Upgrade of the Textile Industry (2023-2025) also lists green manufacturing as a key direction.

Current academic research has obvious shortcomings: most literature focuses on macro-industrial policies or single-enterprise environmental technologies, lacking a layered study that uses HS codes as the standard to quantify the environmental load by product category. This makes it difficult to answer three core questions: which export products must undergo transformation, which categories have the highest transformation priority, and how to achieve trade green upgrading by adjusting product structure. Against this background, a

study on green transformation paths with product structure as the entry point has strong theoretical and practical value.

2. China's Textile and Apparel Export Product Structure

2.1 Classification of China's Textile and Apparel Export Product Structure

China's textiles and apparel are all classified under Section XI of the Customs Tariff: Textile Raw Materials and Textile Articles (Chapters 50 to 63). According to the upstream and downstream of the industry chain, weaving process, and product form, they can be divided into three levels: upstream textile raw materials, midstream textile products, and downstream garments, each corresponding to a clear HS code range, forming a complete export product structure system.

Table 1. Textiles and Apparel HS Codes

Category	Code	Description
Textile Raw Materials	50	Silk
	51	Wool, fine or coarse animal hair; horsehair yarn and woven fabric
	52	Cotton
	53	Other vegetable textile fibers; paper yarn and woven fabrics
	54	Man-made filaments; strip and the like of man-made textile materials
	55	Man-made staple fibers
	56	Wadding, felt and nonwovens; special yarns; twine, cordage, ropes and cables and articles thereof
	57	Carpets and other textile floor coverings
Textile Products	58	Special woven fabrics; tufted textile fabrics; lace; tapestries; trimmings; embroidery
	59	Impregnated, coated, covered or laminated textile fabrics; textile articles of a kind suitable for industrial use
	60	Knitted or crocheted fabrics
	61	Articles of apparel and clothing accessories, knitted or crocheted
Garments	62	Articles of apparel and clothing accessories, not knitted or crocheted
	63	Other made-up textile articles; sets; worn clothing and worn textile articles; rags

Source: Compiled from China Customs and United Nations Trade Database.

2.2 Overall Characteristics of China's Export Product Structure

From the customs export data of the past five years, the product structure exhibits a "three high shares" feature:

(1) High share of high-carbon chemical fiber products: Chapters 54 and 55 (synthetic fiber raw materials, chemical fiber fabrics, and chemical fiber knitted garments) together account for about 42% of the industry's export value (based on China Customs data for 2021-2025).

(2) High share of primary printed and dyed intermediate products: such as cotton and chemical fiber grey fabrics, printed fabrics, accounting for about 31% of exports.

(3) High share of short-cycle fast-fashion garments: low-price knitted T-shirts, thin fast-fashion clothing (low-end categories of Chapter 61) account for about 60% of total garment export volume, with low added value and high environmental damage.

Green and low-carbon products (regenerated fiber products, organic cotton garments, bio-based fabrics) account for less than 12% of exports, highlighting the serious green imbalance in the product structure.

3. High Environmental Load Product Structure

Combining carbon emission intensity, pollution emissions, and the intensity of EU CBAM and environmental regulations, this paper identifies four categories with the highest priority and greatest transformation urgency, with corresponding HS code ranges and environmental risks:

3.1 Virgin Synthetic Fibers and Chemical Fiber Grey Fabrics (Chapters 54, 55)

Core environmental pain points: Made from petroleum, polymerization and spinning processes are extremely energy-intensive. According to LCA data, the carbon footprint of virgin polyester fiber in the production stage is about 2.4-4.5kg CO_2e/kg (based on China's average grid emission factor). When the full life

cycle (including microplastic release during washing and waste disposal) is considered, the environmental impact is further amplified. In addition, microplastics are released during washing and the EU has listed them as a key concern.

Trade risks: Although CBAM does not yet directly cover textile finished products, its upstream petrochemical raw materials have been included in the tax scope, increasing cost pressure for chemical fiber products; international brands are gradually phasing out orders for 100% virgin chemical fiber fabrics.

3.2 Conventional Cotton Printed and Dyed Fabrics and Denim Woven Products (Chapters 52, 62)

Core environmental pain points: Traditional cotton cultivation uses large amounts of fertilizer and pesticides; denim stone-washing and enzyme-washing processes consume a lot of water (about 100-150 tons of water per ton of fabric), with high-salt, high-color-wastewater and large solid waste emissions.

Trade risks: The EU Water Framework Directive restricts the import of high-water-consumption products, and many countries have introduced mandatory carbon labeling for denim products.

3.3 Low-end Disposable Fast-fashion Knitted Garments (low-end Categories of Chapter 61)

Core environmental pain points: Single product life cycle is only 3-5 wears; they are difficult to degrade when landfilled after disposal; they often use low-cost heavy dyeing and finishing processes with high risk of chemical residue exceedances; export volume is large, unit value is extremely low, and the ability to absorb green premiums is weak.

Trade risks: The EU Ecodesign for Sustainable Products Regulation (ESPR) imposes circular design requirements on fast-fashion products; some member states intend to restrict the circulation of disposable textile consumer goods.

3.4 Coated, Impregnated Chemical Fiber Special Fabrics (Chapter 59)

Core environmental pain points: Production uses PVC, PFAS (per-and polyfluoroalkyl substances) and other persistent chemical pollutants, which cannot be naturally degraded after disposal. PFAS are now fully restricted by the EU REACH regulation.

Trade risks: The REACH regulation strictly controls perfluorinated chemicals; non-compliant products face return and destruction.

4. Green Transformation Path of Textile and Apparel Trade

With the core logic of "adjust structure, reduce load, enhance value, circularize", the transformation advances along four paths simultaneously: supply-side product category adjustment, global value chain green upgrading, domestic and international market policy coordination, and whole-industry-chain circular product system, aiming to achieve a green restructuring of the export product structure.

4.1 Supply-Side Product Structure -"Increase Excellent, Decrease Inferior" Optimization

Gradually reduce the export share of virgin polyester grey fabrics, low-end fast-fashion knitted products, traditional denim, and PFAS-coated fabrics. At the enterprise level, control the capacity of high-risk categories such as 5402 and 6109, and reduce orders for low-value-added disposable clothing. At the government level, use differentiated export tax rebates and carbon quota controls to force capacity contraction. Establish a "Product Greenness Index" to implement tiered management of export products according to HS codes: green Level 1 products enjoy customs clearance and credit incentives; high-carbon Level 3 products are subject to mandatory carbon footprint declaration, achieving dynamic optimization of the product structure.

4.2 Global Value Chain Green Upgrading

Currently, China's high-environmental-load products are concentrated in the low-end manufacturing stage of the value chain. By upgrading products to both ends-R&D, green certification, and independent brands-the cost pressure of green transformation can be mitigated:

(1) Product function upgrading: Upgrade ordinary chemical fiber fabrics to antibacterial, sun-protective, biodegradable functional fabrics, increasing unit product premium to cover the cost increases from renewable raw materials and clean processes.

(2) Green certification-enabled product value addition: For products exported to the EU and North American markets, complete LCA carbon footprint accounting and obtain international

green labels such as GOTS organic certification and OEKO-TEX Standard 100 environmental certification to capture green premiums.

(3) Independent brand green export: Reduce OEM fast-fashion orders and cultivate domestic sustainable clothing brands. Rely on high-value-added independent brands to reduce dependence on low-end high-carbon product exports.

(4) Develop technical textiles: Expand exports of high-end eco-friendly geotextiles and medical biodegradable textile materials under Chapter 63, replacing a share of civil low-end garment exports and optimizing the product value structure.

4.3 Domestic and International Market Policy Coordination

Provide institutional support for product structure green transformation through coordinated internal and external policies and tiered market layout:

(1) Differentiated domestic industrial policy guidance

Fiscal level: Provide R&D subsidies for green products such as regenerated fiber fabrics and organic cotton garments; increase environmental taxes and carbon quota prices for virgin chemical fiber and heavily polluting printed and dyed products.

Financial level: Introduce green credit to preferentially support green product production line transformation, and restrict new capacity loans for high-carbon products.

Standard level: Unify the carbon footprint accounting standard for textile products (aligning with ISO 14067, PAS 2050, etc.), and establish an environmental database for products corresponding to HS codes, facilitating enterprises to self-check and adjust export categories.

(2) Differentiated international market layout

High-end green markets (EU, Nordic countries): Completely phase out urgently transformable high-pollution products; only export green products with complete carbon footprint certification.

RCEP emerging markets: Progressively advance product upgrades, gradually replace virgin chemical fiber raw materials, and prepare low-carbon products in advance.

Avoid dependence on a single market, diversify trade risks, and create a buffer period for product structure adjustment.

(3) Proactively align with international green trade rules

In response to CBAM (fully implemented from January 1, 2026) and the EU textile digital passport (phased under the ESPR framework), establish carbon files for export products by HS code, complete embedded carbon accounting in advance to avoid additional carbon tariff costs; actively participate in the formulation of global textile green standards to enhance the international recognition of China's green products.

5. Conclusion

This paper uses Customs HS codes as the standard to layer the structure of textile and apparel export products, confirming that the imbalance in China's export product structure is the core constraint on the industry's green transformation: upstream virgin chemical fiber raw materials, midstream traditional printed and dyed fabrics, and downstream low-end fast-fashion knitted garments constitute the main body of high environmental load and belong to the short-term urgent transformation categories. All textile products across the entire chain have varying degrees of resource and environmental damage, requiring continuous green improvement over the medium and long term.

The four-dimensional transformation path based on product structure optimization is operationally feasible: the supply side directly adjusts the scale of export categories through "increasing the excellent and decreasing the inferior"; value-chain upgrading digests green transformation costs through product value addition; policy-market coordination provides institutional and market space for structural adjustment; the circular product system reduces product carbon footprint from the life-cycle foundation.

Looking ahead, the industry, enterprises, and government should implement tiered policies: enterprises should prioritize reducing capacity of high-carbon urgent transformation products and increase R&D and export of regenerated fiber green products; industry associations should build a shared HS-code product carbon footprint database; the government should introduce differentiated fiscal, tax, and credit policies to guide the green restructuring of product structure, helping China's textile and apparel trade break through global green trade barriers and achieve high-quality sustainable development of foreign

trade.

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