



Whitepaper

Weaving the Circular Future

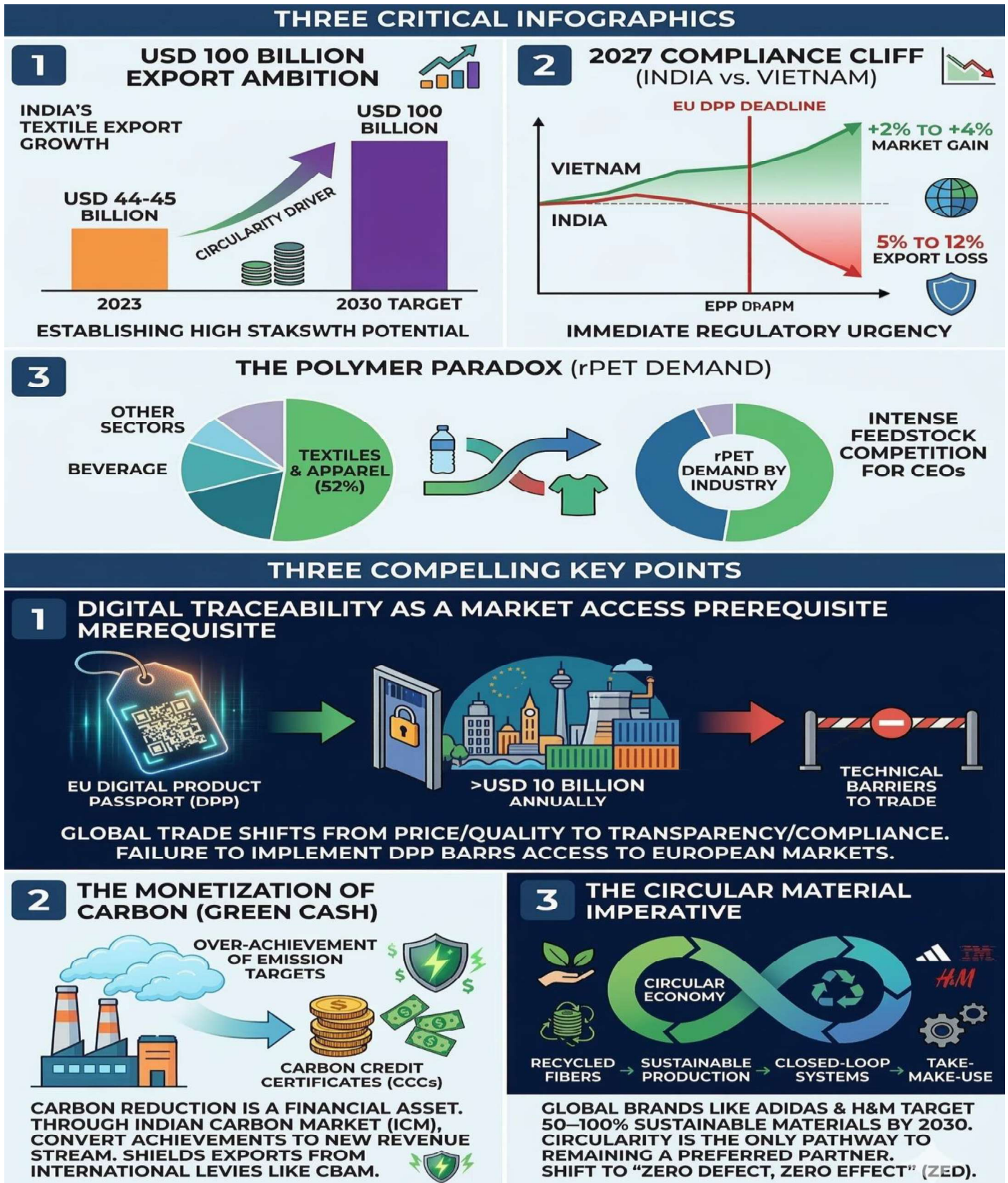
Strategic Imperatives for Indian Textiles
& Plastics



Contents

Section 1: Executive Summary	3
Section 2: Introduction	4
2.1 The Triple Challenge: Compliance, Cost and Circularity	5
Section 3: The New Global Trade Order: Regulatory Headwinds and Tailwinds	7
3.1 The Expanding Scope of Carbon Regulation	7
3.2 Free Trade Agreements as Catalysts for Sustainable Trade	7
3.3 ESG as a Strategic Market Differentiator	7
Section 4: Policy Enablers: Building the Foundations of Circular Manufacturing	8
4.1: Union Budget 2026-27: New Green Trade Paradigm: Integrating the Indian Carbon Market (ICM) into Textile Export Policy	8
4.2 Green Financing and Green Bonds	9
4.3 Samarth 2.0: Building Skills for a Circular Textile Economy	9
4.4 PM MITRA Mega Textile Parks	10
4.5 The National Fiber Policy	10
4.6: Extended Producer Responsibility for Textiles: Upcoming Mandate	10
Section 5: The Digital Backbone: Traceability in the Age of Transparency	11
5.1 Digital Product Passports: An Immediate Regulatory Barrier	11
5.2 Lifecycle Assessment as a Strategic Tool	12
Section 6: The Plastic-Textile Nexus: Understanding the Polymer Paradox	13
6.1 Growth of the rPET Market	13
6.2 Extended Producer Responsibility and Plastic Waste Management	14
6.3 The Feedstock Competition: Bottle-to-Bottle vs Bottle-to-Fiber	14
Section 7: Global Benchmark: China–Vietnam–India Sustainability Competitiveness	16
Section 8: Empowering the MSME Sector	17
Section 9: Strategic Roadmap: The Intueri Circular Textile Framework	21

Key Trends at a Glance



Section 1: Executive Summary

The Indian textile and apparel sector represents one of the most extensive manufacturing ecosystems globally. The sector contributes approximately 2.3% of India's GDP and nearly 12% of the country's export earnings, while providing direct employment to more than 45 million workers and indirect livelihoods to nearly 100 million individuals across agriculture, manufacturing, logistics, and retail value chains. (Source: Ministry of Textiles, Government of India, Annual Report 2024).

Yet the sector faces a defining challenge as global trade is no longer just about price and quality. High global competitive index and access to premium markets now demand demonstratable compliance with emerging circular economy mandates, digital product traceability, and rigorous carbon accountability standards. It demands a fundamental repositioning of India's textile manufacturers as responsible, digitally enabled, and environmentally credible partners in global supply chains. The gap between current manufacturing practices and mandatory requirements is real but it is bridgeable, with decisive leadership action taken now.

Call to Action: Immediate steps for CEOs

To navigate the transition toward a USD 100 billion export target and ensure seamless access to the European market, leadership must prioritize digital and environmental readiness. These strategic actions will help bridge the gap between current manufacturing practices and the mandatory requirements of the circular economy.

1. **Initiate Carbon Footprint Baseline:** Assess current emissions to meet global reporting standards and identify efficiency gains.
2. **Pilot GS1 Traceability:** Implement digital identifiers (QR codes/GS1) to prepare for mandatory Digital Product Passports (DPP).
3. **Secure Green Credit Lines:** Explore sustainable financing to fund the transition to renewable energy and circular processing infrastructure.

Section 2: Introduction

India currently exports approximately USD 44–45 billion in textiles and apparel annually, making it the sixth largest textile exporter globally. However, government and industry stakeholders have articulated a far more ambitious trajectory: expanding exports to USD 100 billion by 2030 while positioning India as the preferred sourcing hub for global fashion brands.



Source: Ministry of Textiles

Three structural shifts are particularly important to drive the incremental production expansion.

1. First, global fashion brands are increasingly transitioning toward circular material systems, emphasizing recycled fibers and waste recovery. According to the Textile Exchange Preferred Fiber and Materials Market Report, recycled polyester production has increased fourfold over the past decade, surpassing 8 million tonnes annually.
2. Second, supply chain transparency is becoming a non-negotiable requirement. New regulatory frameworks in the European Union will require garments to carry digital product passports containing detailed environmental and material information.
3. Third, governments and consumers alike are demanding measurable reductions in the environmental footprint of textile production. Fashion currently accounts for 8–10% of global greenhouse gas emissions, surpassing aviation and maritime shipping combined. (Source: UN Environment Programme).

To ensure supply chain transparency, the European Union's Digital Product Passport (DPP) has transitioned from a concept to a core strategic requirement for market access. This mandatory regulatory shift is creating global pressure, prompting India to position its industry through advanced digital traceability systems. Collectively, these transformations offer a unique opportunity for India to lead the world in sustainable textile manufacturing.

As a critical component of this change, the DPP is becoming the backbone of circular supply chains. Under the EU's Ecodesign for Sustainable Products Regulation (ESPR), garments must eventually carry digital records detailing their origin, material composition, environmental footprint, and recycling pathways. For Indian exporters shipping over USD 10 billion in textiles to Europe annually, adopting these "digital twins" is no longer optional but a prerequisite for staying in the market. By providing instant access to repair and waste-recovery data, DPPs bridge the information gap between manufacturing and end-of-life recovery.

India is strategically aligning with these mandates by integrating specialized Traceability Training into national programs like Samarth. This initiative prepares the workforce to use data carriers like QR codes and GS1 identifiers, creating a physical-to-digital bridge for every garment. This digital backbone does more than just facilitate compliance with the EU's ESPR framework; it positions Indian manufacturers as trusted partners by offering real-time insights into a product's entire lifecycle, from fiber origin to recycling.

2.1 The Triple Challenge: Compliance, Cost and Circularity

While the opportunity is substantial, Indian textile manufacturers must navigate a complex transition defined by three interrelated challenges: regulatory compliance, investment costs, and circular material availability.

Compliance Pressure

Global textile markets are witnessing a wave of new regulatory frameworks designed to improve environmental performance and supply chain transparency. Among the most significant developments is the European Union's Ecodesign for Sustainable Products Regulation, which will mandate digital product passports for textiles and impose stricter product lifecycle disclosure requirements.

These regulations will require exporters to provide detailed information on:

- Fiber origin
- Chemical usage
- Carbon footprint
- Recycling pathways

For exporters serving European markets, where India currently ships over USD 10 billion worth of textiles annually, compliance will become a prerequisite for market access. (Source: WTO Trade Statistics).

Rising Transition Costs

Adapting to these new regulatory expectations requires substantial investments in cleaner production technologies. Textile manufacturers must increasingly deploy:

1. Renewable energy systems

Textile manufacturing is traditionally an energy-intensive process that relies heavily on fossil fuels. Transitioning to Renewable Energy Systems involves installing large-scale solar PV arrays on the expansive rooftops of garment factories and integrating Battery Energy Storage Systems (BESS) to manage power loads during high-demand spinning cycles. The waste heat recovery units can capture the immense energy generated during the "setting" and "finishing" of fabrics, recycling heat back into the boilers and drastically reducing the facility's overall carbon intensity.

2. Advanced wastewater treatment plants

The textile industry is one of the world's largest consumers of freshwater, and the "wet processing" stage often results in toxic effluent. By using advanced wastewater management techniques, factories can strip dyes, salts, and heavy metals from the water. This allows the facility to recycle up to 95% of its process water back into the dye vats. The "closed-loop" water system is critical for factories operating in water-stressed regions, ensuring that no untreated chemical waste ever reaches local rivers or groundwater.

3. Low-impact dyeing technologies

Dyeing and finishing are responsible for most of the the industry's environmental impact. Low-impact dyeing technologies replace traditional, water-heavy immersion vats with innovative solutions. Digital Inkjet Printing allows for precision colouring, applying dyes only where needed on the fabric surface. This eliminates the need for 'screen washing' and reduces overall chemical and water consumption.

4. Circular material processing infrastructure

This infrastructure focuses on turning textile "waste" into a resource. This involved setting up "Recycling Hubs" equipped with AI-based optical sorters that can distinguish between natural fibres (like cotton) and synthetics (like polyester) at high speeds. Chemical Recycling

plants can break down blended “poly-cotton” fabrics into their base compounds. This allows a brand to take back old garments and transform them into new yarn, effectively closing the loop on the textile lifecycle.

Circular Material Demand

The third structural challenge concerns the availability of recycled fibers. Global brands are rapidly shifting toward recycled materials as part of their sustainability commitments. Companies such as Adidas, H&M, and Nike have announced targets to source 50–100% recycled or sustainable materials by 2030.

As a result, global demand for recycled polyester is expected to increase significantly over the next decade.

However, this demand surge is colliding with competing requirements in the beverage industry, where regulations increasingly mandate recycled content in plastic bottles. This creates a strategic tension over the allocation of recycled PET feedstock, an issue examined in detail later in this paper as the Polymer Paradox.

Section 3: The New Global Trade Order: Regulatory Headwinds and Tailwinds

3.1 The Expanding Scope of Carbon Regulation

The Indian Carbon Market (ICM) has formally expanded its compliance mechanism to include the textile sector, marking a pivotal shift from voluntary sustainability to a regulated decarbonization framework. Following the Ministry of Environment, Forest and Climate Change (MoEFCC) notification on January 13, 2026, a total of 173 textile units has been designated as Obligated Entities, required to meet specific Greenhouse Gas Emission Intensity (GEI) reduction targets. Using FY 2023–24 as a baseline, these units must achieve a 2% reduction in 2025–2026, transitioning to a 2.5% target by 2026–2027. This inclusion integrates the industry into a market-based credit system where over-achievement generates Carbon Credit Certificates (CCCs), while deficits necessitate their purchase. This regulatory evolution is strategically timed to bolster the global competitiveness of Indian textiles, aligning domestic production with international carbon-border requirements like the EU's CBAM.

Although textiles are not yet directly covered under the EU Carbon Border Adjustment Mechanism (CBAM), carbon disclosure requirements are rapidly expanding across sectors. CBAM currently applies to carbon-intensive industries such as steel, cement, aluminium, fertilizers, electricity, and hydrogen. However, policy analysts widely expect that future product-level carbon regulations will extend into consumer goods sectors including textiles.

The expanding scope of the European Union Deforestation Regulation (EUDR) could also become a motivating factor that necessitates the transformation of global trade practices within the fashion and textile sectors. The future considerations to bring cotton and Man-Made Cellulosic Fibres (MMCF) within the purview of EUDR could make transparency a requirement and opportunity for global suppliers. The European Union is already developing Product Environmental Footprint (PEF) methodologies that will quantify lifecycle emissions for consumer products, including garments. Once implemented, exporters will need to demonstrate lower embedded carbon emissions to remain competitive.

For Indian textile exporters, this development highlights the importance of transitioning toward renewable energy-powered manufacturing clusters and energy-efficient production technologies.

3.2 Free Trade Agreements as Catalysts for Sustainable Trade

India's expanding network of free trade agreements represents a major opportunity for textile exports. Agreements with the United Arab Emirates (CEPA) and Australia (ECTA) have already reduced tariffs on several textile products, while negotiations with the European Union and the United Kingdom promise access to some of the world's largest apparel markets. The India-Qatar FTA could also open new markets where there is large scale demands for apparel products, institutional wear, and home textiles.

However, modern trade agreements increasingly incorporate sustainability provisions related to labour rights, environmental performance, and supply chain transparency. Consequently, non-compliance no longer just carries reputational risk, but now presents a direct financial barrier through the loss of preferential trade status and the imposition of "green" border adjustments. As a result, ESG compliance is becoming an implicit condition for benefiting from tariff concessions.

3.3 ESG as a Strategic Market Differentiator

Beyond regulatory compliance, sustainability is becoming a powerful differentiator in consumer markets. A 2023 Deloitte global survey found that more than 55% of consumers prefer brands with strong sustainability credentials, while nearly one-third are willing to pay a premium for environmentally responsible products.

For Indian textile exporters, this shift offers a strategic opportunity. Companies that successfully embed ESG frameworks within their operations may gain preferential supplier status with global brands seeking to decarbonize their supply chains.

Section 4: Policy Enablers: Building the Foundations of Circular Manufacturing

India has introduced several policy initiatives aimed at strengthening the textile ecosystem while encouraging sustainable manufacturing practices.

4.1: Union Budget 2026-27: New Green Trade Paradigm: Integrating the Indian Carbon Market (ICM) into Textile Export Policy

The Union Budget 2026–27 has formally positioned the textile sector as a "Champion Sector" for sustainable manufacturing, introducing the Tex-Eco Initiative to align domestic production with global green standards. A pivotal development is the January 2026 notification under the Carbon Credit Trading Scheme (CCTS), which officially designates 173 large-scale textile units as "Obligated Entities." These units are now required to meet specific Greenhouse Gas Emission Intensity (GEI) targets. By shifting from the previous energy-saving (PAT) model to an emission-based ICM framework, the government has turned carbon reduction into a financial asset. Under this mechanism, textile exporters who over-achieve their decarbonization targets earn Carbon Credit Certificates (CCCs), which provide a dual-stream of revenue: through domestic trading and by acting as a "carbon-shield" against international levies like the EU's Carbon Border Adjustment Mechanism (CBAM).

The Union Budget 2026-27 codifies the Tex-Eco Initiative as a strategic fiscal engine to transition the textile sector from a volume-led to a value-and-sustainability-led model. By codifying the Tex-Eco Initiative, the budget directly incentivizes the following foundational principles of textile circularity:

- **Design for Longevity and Recyclability:** Shifting the focus from fast fashion to durable, modular designs that allow for easier disassembly and fiber recovery at end-of-life.
- **Resource Intensity Decoupling:** Implementing technologies like Zero Liquid Discharge (ZLD) and air-dyeing to decouple industrial growth from freshwater consumption and chemical runoff.
- **Material Integrity and Substitution:** Prioritizing the transition to benign chemicals and "tree-free" fibers derived from agricultural residues, reducing the sector's reliance on virgin polyester and water-heavy cotton.
- **Closed-Loop Logistics:** Establishing regional "Circularity Hubs" that facilitate the collection, sorting, and upcycling of pre-consumer and post-consumer textile waste back into the production stream.

The 2026-27 Budgetary directives transform these principles into a competitive mandate for exporters. By linking the SME Growth Fund and enhanced Export Obligation Periods to a firm's Greenhouse Gas Emission Intensity (GEI), the government has made circularity the primary pathway to securing Carbon Credit Certificates (CCCs).

Furthermore, the NITI Aayog "Roadmap for Green Transition of MSMEs" (2026) and the Vision 2030 export targets (aiming for \$100 billion in exports) specifically link fiscal incentives to carbon performance. The 2026 budget has extended the Export Obligation Period from six to twelve months for sustainable textile manufacturers, providing the necessary liquidity to invest in the circular technologies. This policy shift ensures that export incentives previously focused solely on volume are now increasingly tied to the adoption of the "6 Rs of Circularity" (Redesign, Reuse, Repair, Remanufacture, Recycle, and Repurpose).

As outlined in the NITI Aayog's Net-Zero Pathways (2026), the textile sector's transition is no longer voluntary but a core component of "Viksit Bharat" (Developed India). The alignment of the Tex-Eco Initiative with the ICM allows firms to utilize circular economy interventions—such as agricultural waste-to-fiber conversion and closed-loop supply chains to meet their Greenhouse Gas Emission Intensity (GEI) benchmarks. Policy guidelines now emphasize that the SME Growth Fund (₹10,000 crore) will prioritize "Champion SMEs" that demonstrate high circularity scores and carbon efficiency. This creates a powerful synergy: circularity reduces the resource footprint, which in turn lowers carbon intensity, enabling exporters to bypass "double taxation" in foreign markets while accessing preferential domestic credit and export-linked incentives.

4.2 Green Financing and Green Bonds

The Indian textile sector is currently undergoing a significant "green revolution" driven by the need to address its environmental impact as a water-intensive and energy-hungry industry. To support this transition, the Ministry of Textiles is proposing a CIBIL-style green credit rating system and a centralized Green Fund. This initiative aims to provide standardized assessments of firms based on their financial health and compliance with Environmental, Social, and Governance (ESG) norms. By offering transparent insights into a company's sustainability, the system is designed to reduce lending risks and streamline access to capital for eco-friendly operations.

Strategic Financial Initiatives

The government's strategy focuses on creating a unified sustainable financing platform to pool funds and simplify the disbursement process, which is particularly beneficial for Micro, Small, and Medium Enterprises (MSMEs). Key features of this financial framework include:

- **Access to Cheaper Capital:** Eco-conscious manufacturers can secure loans at preferential interest rates through green bonds or sustainability-linked credit. This pivot transforms ESG compliance from a cost centre into a strategic financial asset that improves long-term balance sheet resilience.
- **Targeted Investments:** The Green Fund provides dedicated support for energy efficiency upgrades, renewable energy adoption, water conservation, and cleaner production technologies. These capital injections act as a catalyst for technological leapfrogging enabling factories to bypass outdated, inefficient machinery in favour of high-precision, low-emission infrastructure that delivers immediate operational savings.
- **MSME Empowerment:** Enhanced credit visibility helps smaller players overcome challenges related to weak collateral, allowing them to upgrade technology and remain competitive. This levelled playing field ensures that the entire supply chain can achieve the technical standards required for global market entry.

Global Competitiveness and Future Goals

These financing initiatives align with India's national climate targets and the goal of reaching a \$350 billion textile industry value by 2030. By incentivizing ESG-compliant practices, the framework helps Indian firms prove their credentials to international buyers in markets like the EU and UK, where verifiable sustainability metrics are increasingly demanded. Furthermore, programs like Project SU.RE and the InTex India programme complement these financial tools by encouraging the use of sustainable raw materials and circular manufacturing practices. Ultimately, this push toward green financing positions India as a global hub for ethical and eco-friendly textiles while supporting the country's 2070 net-zero emissions target.

4.3 Samarth 2.0: Building Skills for a Circular Textile Economy

The Samarth Scheme for Capacity Building in the Textile Sector seeks to train more than one million workers across the textile value chain. While the program has historically focused on improving productivity and employment outcomes, future iterations could play a crucial role in preparing the workforce for circular manufacturing.

Training programs could incorporate modules on:

- Sustainable dyeing techniques
- Textile waste recovery systems
- Recycling technologies
- Environmental compliance standards

4.4 PM MITRA Mega Textile Parks

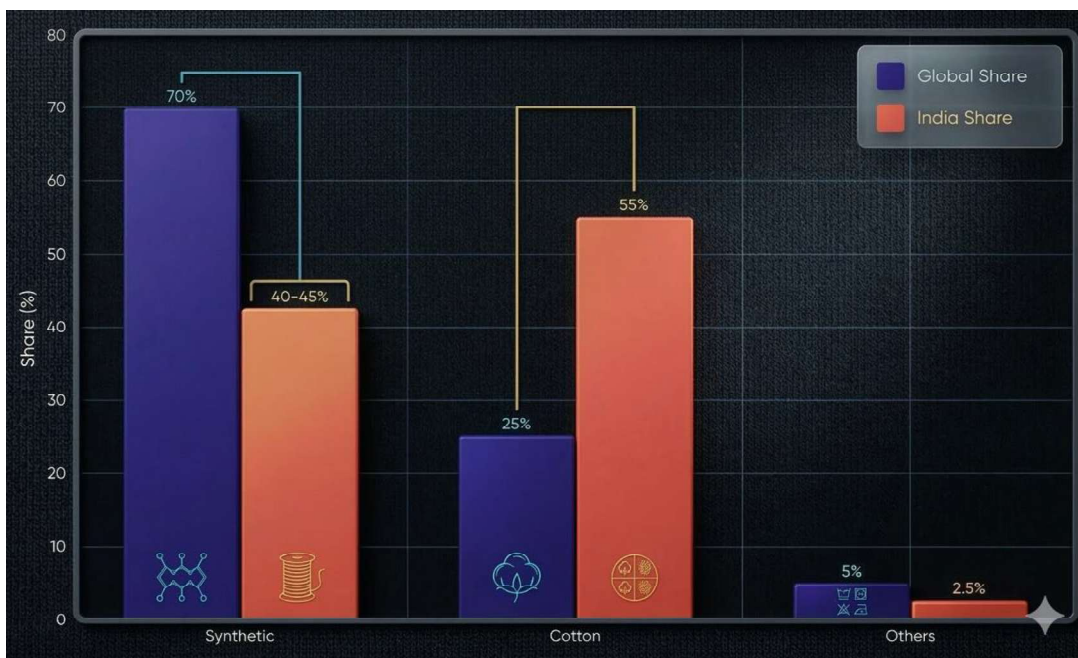
The PM MITRA (Mega Integrated Textile Region and Apparel) scheme represents one of the most significant infrastructure initiatives in the Indian textile sector. The program aims to establish seven large-scale textile manufacturing clusters supported by world-class infrastructure. The scheme is expected to attract investments exceeding ₹70,000 crore (approximately USD 8.5 billion).

Beyond economic benefits, these integrated parks present an opportunity to embed circular economy principles from the outset. Shared infrastructure for wastewater treatment, renewable energy generation, and waste recycling can significantly reduce the environmental footprint of textile production.

4.5 The National Fiber Policy

India’s textile sector remains heavily dependent on cotton, despite the global shift toward synthetic fibers. Globally, synthetic fibers account for nearly 70% of textile consumption, whereas India’s fiber consumption remains more evenly split between natural and synthetic materials.

Fiber Consumption: India vs Global



Source: NITI Aayog; Textile Exchange.

4.6: Extended Producer Responsibility for Textiles: Upcoming Mandate

While India’s Plastic Waste Management Rules of 2022 have already embedded EPR obligations for plastic producers, the textile sector now stands at the threshold of its own reckoning. The Ministry of Textiles and MoEFCC are actively deliberating a dedicated EPR framework for textile waste one that would require brands, manufacturers, and importers to take financial and operational responsibility for the end-of-life management of garments they place in the market. An EPR mandate would compel manufacturers to invest in take-back infrastructure, textile-to-textile recycling, and circular design from the outset, while simultaneously creating a formal market for recycled fiber certificates. Crucially, it also aligns Indian domestic policy with the EU’s incoming Extended Producer Responsibility requirements under the Environment, Science and Political Research (ESPR) framework, ensuring that the same circular logic governing access to European markets is mirrored within India’s own production ecosystem.

Section 5: The Digital Backbone: Traceability in the Age of Transparency

5.1 Digital Product Passports: An Immediate Regulatory Barrier

The Digital Product Passport (DPP) is rapidly evolving from a transparency concept into the mandatory "digital backbone" of circular supply chains. While often discussed as a future goal, the DPP now represents an immediate regulatory barrier; under the EU's Ecodesign framework, textiles will be required to carry digital records detailing their entire lifecycle. For Indian exporters, failure to implement these digital traceability systems by 2027 may result in goods being classified as "Technical Barriers to Trade," effectively severing access to European markets.

The European Union DPP aims to enhance transparency across product value chains by providing comprehensive information about each product's origin, material, environmental impact, and disposal recommendations. It is designed to reduce the gap between consumer demand for transparency and the current lack of reliable product data. Specific details such as a unique product identifier, compliance documentation, and information on substances of concern will be included. The DPP would act as digital twins that replicate physical objects, systems, or processes using real-time data and analytics to stimulate real-world behavior.

The Architecture of Compliance

The UN DPP works across several stages to enable consumers, regulators, and business partners to access trusted information about a product's origin, composition, certifications, supply chain journey and environmental footprint. The DPP functions as a "digital twin," using real-time data to replicate a physical product's journey and environmental behaviour. This system is designed to close the data gap between consumer demand for transparency and current fragmented supply chain records.

To satisfy both regulatory audits and consumer queries, the passport integrates several key components:

- **The Physical Bridge:** A QR Code or Data Carrier on the garment acts as the physical key, allowing stakeholders to instantly access the digital twin via smartphone.
- **Unique Identification:** The GS1 Digital Link serves as the unique identifier for every individual item.
- **Dynamic Data Management:** A GS1 link resolver acts as a "traffic controller," enabling manufacturers to update destination webpages and data without needing to change the physical label on the product.
- **Dual-Layer Information:** The system combines machine-readable GS1 EPCIS data (covering manufacturing locations and batch numbers) with human-readable unstructured data, such as PDF certificates and repair manuals.

Essential Data Requirements

The EU DPP aims to enhance transparency by providing a "cradle-to-grave" view of the product. To maintain market access, Indian manufacturers must ensure their digital records include:

- **Material Composition & Substances of Concern:** Detailed breakdown of fibers and any restricted chemicals. By integrating real-time chemical tracking and automated fibre identification, this layer ensures hazardous substances are filtered out before they enter the supply chain. It increases the chances of the final product meeting the strictest global safety standards like REACH.
- **Environmental Footprint:** Data derived from lifecycle assessments, particularly focusing on fiber production and textile processing, which account for 70–80% of a garment's impact. The data serves as a "carbon accounting" baseline, enabling brands to move beyond generic industry averages towards product-specific impact scores that can be used to drive internal decarbonisation strategies and justify "green" price premiums to consumers.
- **Supply Chain Origin:** Verified documentation of the product's journey from raw material to finished good. The DPP provides an immutable audit trail that verifies compliance with international labour laws and prevents the entry of raw materials from environmentally sensitive zones.

- **Circular Pathways:** Specific recommendations for repairability, recycling, and final disposal. These pathways provide consumers and recyclers with the exact technical specifications needed to disassemble, re-spin, or chemically regenerate fibers into new high-value textiles.

By identifying these environmental "hotspots" through the DPP, manufacturers can prioritize interventions that deliver the most significant reductions in emissions, transforming a regulatory hurdle into a strategic tool for resource efficiency.

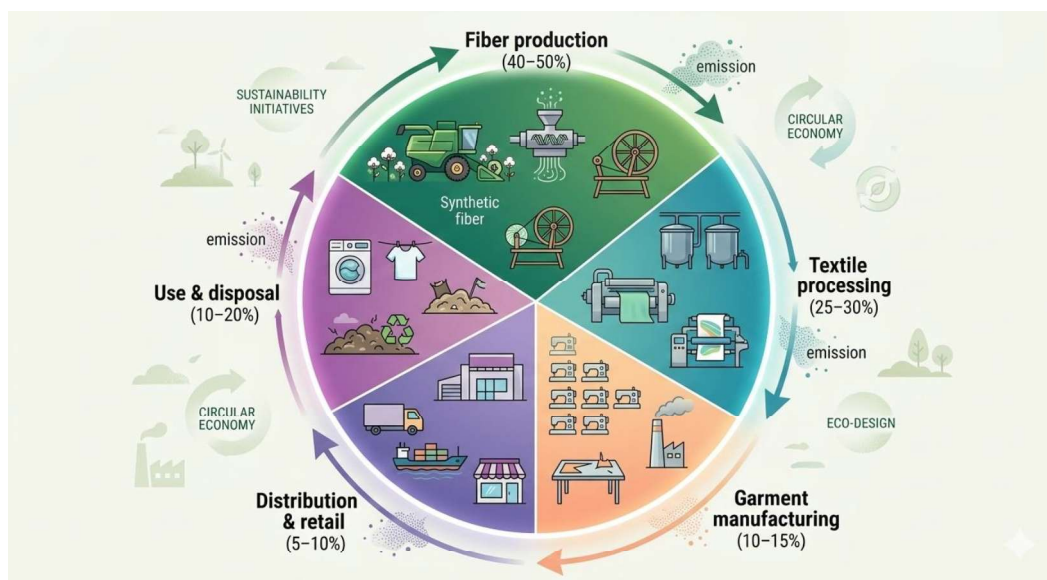
These passports will also include information on:

- Material composition
- Environmental footprint
- Supply chain origin
- Repairability and recycling pathways

5.2 Lifecycle Assessment as a Strategic Tool

Lifecycle assessments provide detailed insights into environmental impacts across production stages. Studies indicate that approximately 70–80% of a garment's environmental footprint occurs during fibre production and textile processing.

Textile Lifecycle Emissions Distribution



Source: Textile Exchange LCA database

By identifying environmental hotspots, manufacturers can prioritize interventions that deliver the greatest reductions in emissions and resource consumption.

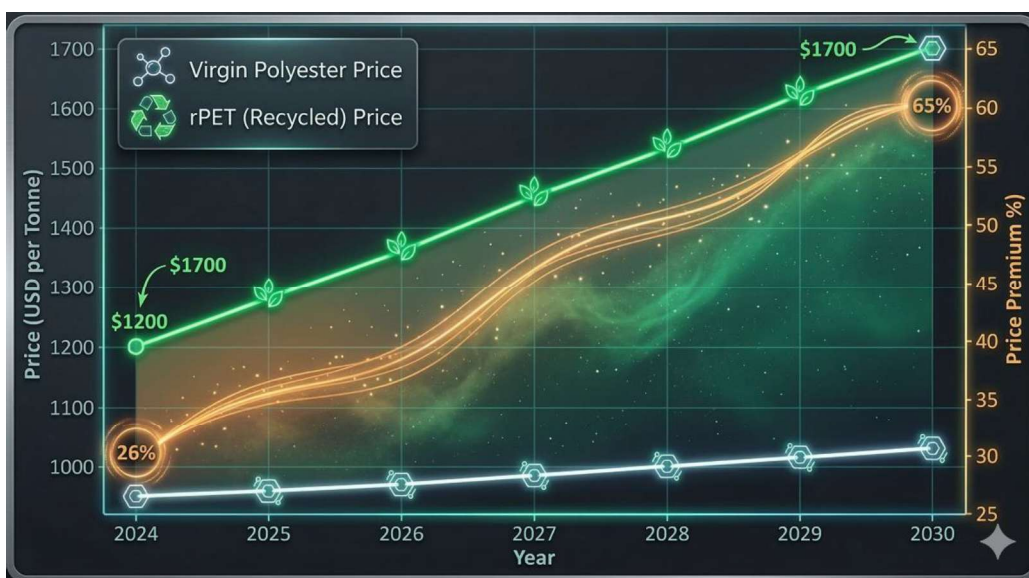
Section 6: The Plastic-Textile Nexus: Understanding the Polymer Paradox

The relationship between plastic recycling and textile manufacturing is becoming increasingly complex as demand for recycled materials accelerates across industries.

6.1 Growth of the rPET Market

Recycled polyethylene terephthalate has become the most widely used recycled fiber in the fashion industry. India is among the world's largest producers of recycled polyester yarn, supported by a large network of PET recycling facilities. Global production has expanded from approximately 2 million tonnes in 2010 to more than 8 million tonnes in 2023. (Source: Textile Exchange).

rPET vs Virgin Polyester Prices (2024-2030)



Sources: Future Market Insights, Textile Exchange, GTRI Report 2026

A critical but underappreciated tension lies at the heart of India's recycling economy: not all plastic waste can be channelled into the textile industry. Of the many plastic polymers in circulation, only polyethylene terephthalate (PET) can be processed into the recycled polyester fibres that the textile sector demands. Once collected, sorted, and shredded into washed flakes, the dried rPET material is primarily sent to textile spinning unit, making the textile industry the dominant consumer of India's recycled PET stream. This recycling pipeline, however, does not begin in factories it begins on the streets.

India's well-established collection ecosystem, supported significantly by the informal sector, recovers an estimated 90% of PET bottles, placing the country among global leaders in PET recycling. An estimated 70% of plastic recycling in India is powered by the informal sector: waste pickers who collect, sort, and sell plastic waste that would otherwise clog rivers, streets, and landfills. The informal solid waste management sector is a critical source of livelihood for some of the country's most economically marginalised communities, predominantly Dalit women, migrants, and minority groups who work without formal recognition, safety equipment, or legal protection.

Globally, textiles and packaging together consume the overwhelming share of all rPET produced, taking it away from use in other industries. India already mandates that all PET bottles contain at least 30% recycled plastic from April 2025 meaning the packaging and plastic products industries now have a legally enforceable demand for rPET of their own. With demand for rPET rising faster than supply, shortages are beginning to disrupt compliance obligations across industries. The result is an internal competition for a shared feedstock: when the textile industry absorbs the bulk of India's recycled PET, it crowds out the plastic industry's own need for recycled material forcing manufacturers to either fall back on virgin plastic or face supply deficits. This dynamic exposes a fundamental flaw in treating rPET

recycling as a singular sustainability win; high recycling rates do not resolve the allocation problem when one industry's circular economy gain becomes another's raw material gap.

6.2 Extended Producer Responsibility and Plastic Waste Management

India's Plastic Waste Management Rules, strengthened through amendments in 2022, introduced comprehensive Extended Producer Responsibility (EPR) obligations for plastic producers and brand owners.

The rules mandate:

- Minimum recycling targets
- Digital tracking of plastic waste flows
- Trading of EPR certificates

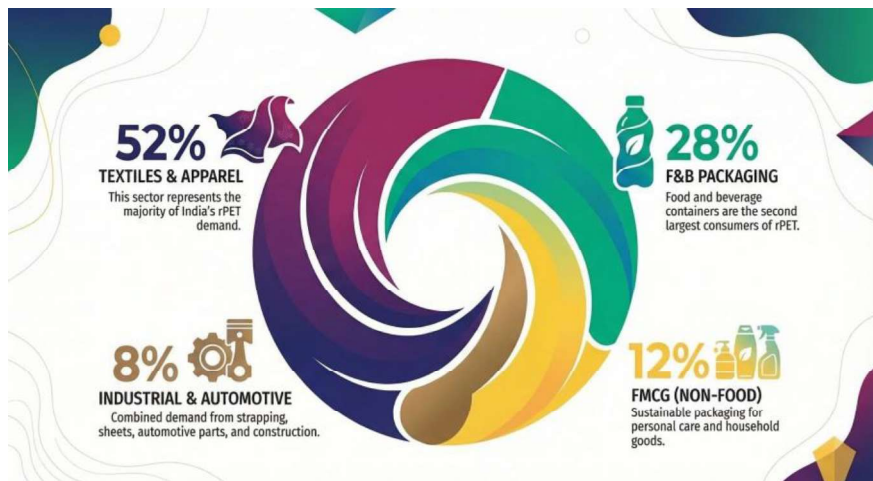
These policies are expected to significantly increase plastic recycling rates across the country.

6.3 The Feedstock Competition: Bottle-to-Bottle vs Bottle-to-Fiber

Despite the growth of recycling infrastructure, the availability of PET feedstock is emerging as a strategic constraint. The European Union has mandated that PET beverage bottles contain 25% recycled plastic by 2025 and 30% by 2030. (Source: EU Single-Use Plastics Directive).

As beverage companies compete aggressively for recycled PET, textile manufacturers may face increasing difficulty sourcing sufficient feedstock for fiber production. This emerging competition for recycled materials, the Polymer Paradox has significant implications for India's textile sector.

India's rPET Demand by Sector (2030 Projection)



Source: ChemAnalyst, TechSci Research, MoEFCC

Intueri Insight Box

The Polymer Paradox Model

The tension between bottle-to-bottle and bottle-to-fiber recycling can be conceptualized as a triangular constraint involving:

1. PET Waste Collection Capacity
2. Food-Grade Recycling Requirements
3. Textile Fiber Demand

Without significant expansion in collection and recycling infrastructure, increasing demand from both sectors will lead to supply shortages and rising raw material prices.

Section 7: Global Benchmark: China-Vietnam-India Sustainability Competitiveness

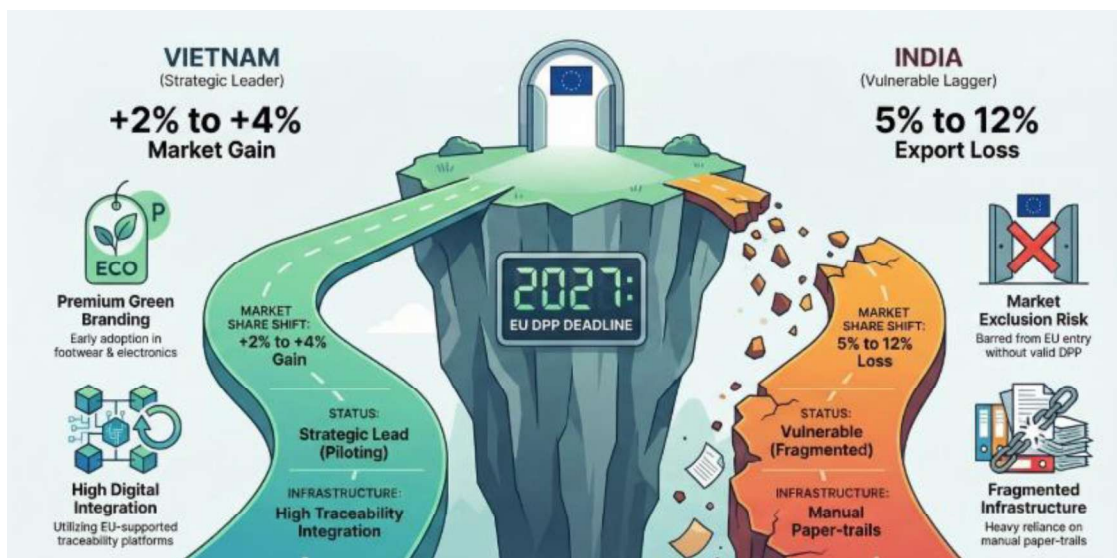
As global apparel brands diversify sourcing away from concentrated supply chains, three Asian manufacturing hubs, China, Vietnam, and India are emerging as key competitors in the sustainable textile economy.

Manufacturing Scale

China remains the world’s largest textile producer, accounting for nearly 40% of global textile exports. Its dominance stems from deeply integrated supply chains, advanced manufacturing infrastructure, and large-scale capacity for synthetic fibre production.

By 2027, Vietnam will likely outperform India in EU market entry because its proactive adoption of Digital Product Passports and established EU-FTA compliance have already created a "green corridor" for its exports. While India faces potential exclusion due to fragmented digital traceability, Vietnam’s early-stage pilots in textiles and electronics allow its goods to clear customs instantly. This regulatory readiness transforms compliance from a barrier into a competitive weapon, potentially siphoning off market share from less-prepared Indian exporters.

2027 Compliance Cliff: India vs Vietnam



Sustainability Capabilities Comparison

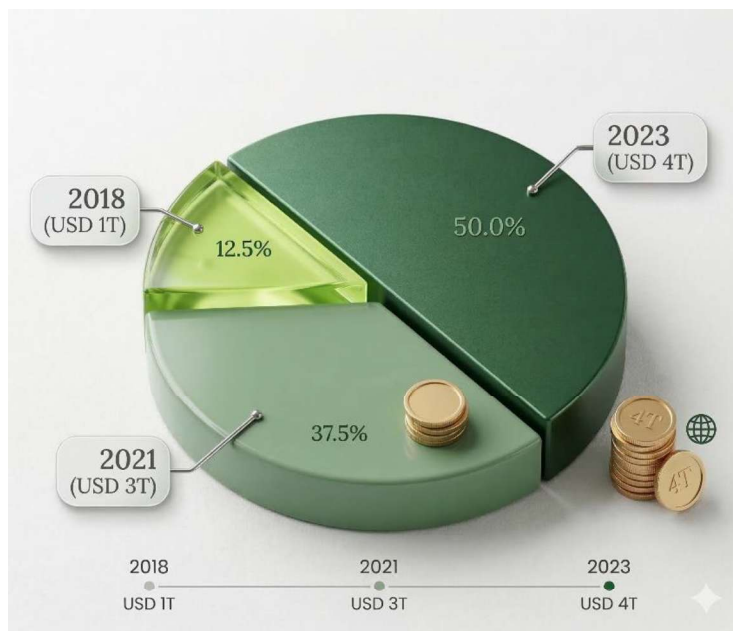
Indicator	China	Vietnam	India
Manufacturing Scale	Very High	Medium	High
Synthetic Fibre Capacity	Very High	Medium	Medium
Recycling Infrastructure	High	Low	Medium
Renewable Energy Adoption	Medium	Medium	Growing
Traceability Systems	Advanced	Developing	Early Stage
Circular Economy Policy	Strong	Emerging	Emerging

Section 8: Empowering the MSME Sector

India’s textile manufacturing ecosystem is dominated by small and medium enterprises. Ensuring that these firms participate in the transition toward circular manufacturing will be essential for achieving sector-wide transformation.

Government support mechanisms should focus on facilitating access to ESG certification, digital traceability technologies, and concessional green finance.

Global Financial Sustainable Growth



Source: Climate Bonds Initiative

Programs that subsidize certification costs and provide technical assistance for sustainability reporting could significantly enhance the competitiveness of smaller manufacturers in international markets.

Empowering MSMEs for Circular Manufacturing

India’s textile ecosystem is dominated by MSMEs. Transitioning these firms to circular manufacturing moving from "take-make-dispose" to "Zero Defect, Zero Effect" is essential for sector-wide transformation and global competitiveness.

Strategic Pillar	Immediate Action (2026)	Long-term Goal (2030)
Carbon Compliance	Register as an "Obligated Entity" under ICM.	Achieve Net Zero in Scope 1 & 2 emissions.
Digitalization	Pilot GS1-based QR codes for high-value exports.	Full Digital Product Passport integration for all EU shipments.
Material Shift	Secure long-term rPET feedstock contracts.	Transition to a fully circular raw material sourcing model

From "Green Rating" to "Green Cash": The ZED and CCTS Synergy

The Zero Defect, Zero Effect (ZED) certification and the Carbon Credit Trading Scheme (CCTS) act as two halves of the same coin for modern MSMEs. While ZED provides the framework to make your business cleaner and more efficient, CCTS provides the "paycheck" for those green efforts by allowing you to sell your carbon savings as a financial asset.

The Link: Turning High Grades into Capital

The ZED certification becomes the business's environmental "report card". It measures your success in reducing waste (Zero Defect) and minimizing pollution (Zero Effect). The Carbon Credit Trading Scheme (CCTS) is the "marketplace" where those high grades are converted into money. By achieving higher ZED levels, such as Silver or Gold, an MSME "pre-qualifies" its green credentials. This makes it significantly easier to verify and sell carbon credits on the Indian Carbon Market (ICM). Under this scheme, every tonne of carbon dioxide your business avoids emitting is converted into a Carbon Credit Certificate (CCC).

How the "Selling" Process Works

The CCTS ecosystem consists of Obligated Entities (large polluters like power plants) and Non-Obligated Entities (MSMEs). The following points demonstrate how MSMEs can monetize their sustainability utilising a combination of ZED certification and carbon credits:

Step 1: Save Carbon through ZED Intervention: To begin, an MSME adopts cleaner technologies, tools, and upgraded processes as encouraged by the ZED initiative. This transition is supported by ZED Handholding, which provides managerial and technological interventions to help the unit move toward zero-effect solutions, pollution control measures, and cleaner technology. By reducing wastage and optimizing natural resources, the MSME effectively lowers its carbon footprint.

Step 2: Rigorous Data Verification: Once emissions are reduced, the "green" data must be validated. A government-accredited agency performs an assessment to check the business's data and confirm the exact volume of emissions avoided. This acts as a formal "report card" of the MSME's environmental performance.

Step 3: Issuance of Carbon Credit Certificates (CCCs): Following successful verification, the Bureau of Energy Efficiency (BEE) officially converts these savings into a tradable format. For every tonne of carbon dioxide avoided, the BEE issues one Carbon Credit Certificate (CCC) to the MSME. Achieving a Silver or Gold ZED level simplifies this stage, as it pre-qualifies the MSME's green credentials for the market.

Step 4: Market Sale to Obligated Entities: The final step occurs in the Indian Carbon Market (ICM), where MSMEs act as "Non-Obligated Entities". Large "Obligated Entities," such as steel mills or power plants, are required by law to meet strict pollution targets; The failure to meet these targets could result in heavy government penalties. The MSME can then sell its CCCs to these large entities through a power exchange, turning its environmental "Zero Effect" efforts into a direct financial profit.

Through this connection, ZED is no longer just a certification for quality; it is a gateway to a new revenue stream that rewards MSMEs commitment to a Zero Effect future.

Policy Levers for Digital & Circular Adoption

To scale sustainable practices, the government focuses on four strategic pillars:

- **Financial & Fiscal Incentives:** Tax breaks for recycled fiber usage and dedicated digital transition funds (grants/low-interest loans) for IoT, ERP, and recycling tech.
- **Infrastructure:** Investment in regional circular ecosystems, including recycling units, collection centers, and sorting hubs.

- **Technical Support:** Subsidizing ESG certification costs and providing assistance for sustainability reporting.
- **Standards & Traceability:** Implementing standardized, digitally verified recycled-content labels to enhance consumer awareness and market trust.

Strategic Realignment of Major Subsidy Schemes

Existing schemes are being repurposed to fund resource efficiency and closed-loop systems:

1. Resource Efficiency and Waste Reduction (ATUFS & PLI)

The Amended Technology Upgradation Fund Scheme (ATUFS) has evolved from a general modernization fund into a tool for source-level waste reduction. By providing capital subsidies of 15–20%, it encourages MSMEs to adopt "benchmarked" technology. This includes energy-efficient shuttle-less looms and high-efficiency motors that lower the carbon footprint per meter of fabric. Simultaneously, the Production Linked Incentive (PLI) Scheme directs ₹10,683 crore toward large-scale investors in man-made fibers and technical textiles, creating the industrial capacity needed to process sustainable alternative materials at scale.

2. Water and Chemical Loop Closing (IPDS)

Water is the most resource-intensive element of textile processing, and the Integrated Processing Development Scheme (IPDS) is the primary mechanism for "closing the loop." It specifically funds the establishment of Common Effluent Treatment Plants (CETPs). These facilities enable Zero Liquid Discharge (ZLD), treating wastewater to a purity level where it can be recycled back into the dyeing process. Advanced IPDS projects even incorporate salt recovery systems, capturing chemicals from effluent to be reused in subsequent production batches.

3. Industrial Symbiosis and Infrastructure (PM-MITRA & SITP)

To eliminate the logistics-heavy "take-make-dispose" model, PM-MITRA Textile Parks and Cluster Schemes (SITP/TCDP) focus on co-location. By gathering the entire value chain—from fiber to fashion—in one "Circular Hub," these parks facilitate Industrial Symbiosis. In this ecosystem, the waste of one unit (such as cotton linters or fabric scraps) immediately becomes the raw material for a neighboring recycling or non-woven unit. Furthermore, these parks provide MSMEs with "plug-and-play" access to renewable energy and centralized waste management that would be cost-prohibitive for a single small enterprise.

4. Knowledge and Skill Circularity (SAMARTH)

Transitioning to a circular model requires a workforce capable of handling new technologies. The SAMARTH scheme has been updated to provide "Green Practice" training, focusing on specialized tasks like sorting textile waste for high-value recycling and operating complex ZLD machinery. Crucially, it also prepares workers for Traceability Training, teaching them to use digital tools like QR codes and scanners. This is a prerequisite for the Digital Product Passport (DPP), which is increasingly required for entry into international circular markets.

State & Complementary Supports

THE BODHJUNGNAGAR ZLD MODEL (TRIPURA)

In the Bodhjungle Industrial Estate near Agartala, the integration of Zero Liquid Discharge (ZLD) has transformed environmental compliance from a "tax" into a strategic business asset for the burgeoning textile and rubber-processing sectors.

The Sustainability ROI Breakdown

- **The Investment:** Deployment of a shared Common Effluent Treatment Plant (CETP) utilizing multi-stage Reverse Osmosis (RO) and Mechanical Vapor Recompression (MVR).
- **The Operational Shift:** Moving away from traditional effluent discharge to a 95% water recovery loop.

The Financial Win

1. **Lower Input Costs:** By recycling 95% of process water, units have decoupled their production costs from the rising price of industrial water procurement.
2. **Chemical Circularity:** Recovered salts from the ZLD crystallizers are fed back into the dyeing process, reducing raw material spending by an estimated 12–15%.
3. **The "GI Tag" Premium:** With products like Tripura Risa gaining Global Identification (GI) status, ZLD compliance provides the "Green Credentials" required to sell into premium international markets that mandate the Digital Product Passport (DPP) by 2027.

- **State-Level Policies:** States like Maharashtra, Odisha, and Gujarat provide additional layers of support, including electricity subsidies, wage subsidies, capital grants, and interest rebates.
- **Micro-Enterprise Support:** The PMEGP offers 15–35% capital subsidies, while the CLCSS assists with machinery upgrades.
- **Export Incentives:** Duty rebates act as indirect subsidies, rewarding manufacturers who meet international sustainability standards.

Pillar	Initiative	Indian Requirement (BRSR/PCB)	Global Benchmark (IFC/EU/GRI)
Water Usage	Specific Water Consumption	~200–250 L/kg of fabric (Avg)	<100 L/kg (IFC Best Practice)
Effluents	Discharge Quality	Focus on pH, TDS, and COD limits	Zero Liquid Discharge (ZLD) & ZDHC MRSL Compliance
Materials	Recycled Content	Voluntary (Increasing focus in BRSR)	Minimum 20–30% (Brand Mandates/EU Strategy)
Chemicals	Restricted Substances	Basic Pollution Control Board norms	REACH (EU) and Oeko-Tex 100 certification
Energy	Renewable Energy Mix	~8% (Current Sector Avg)	RE100 Goals (High focus on solar/biomass)

Section 9: Strategic Roadmap: The Intueri Circular Textile Framework

To successfully navigate the transition toward circular manufacturing, India must adopt a multi-layered strategy encompassing policy alignment, infrastructure development, and technological innovation.

The Intueri Circular Textile Framework proposes five strategic pillars:

1. **Circular Materials** – Scaling textile recycling and rPET availability
2. **Traceable Supply Chains** – Implementing Digital Product Passports
3. **Low-Carbon Manufacturing** – Transitioning toward renewable energy
4. **MSME Inclusion** – Providing financial and technical support
5. **Global Market Alignment** – Harmonizing Indian standards with international regulations

Pillar 1

Circular Materials

The foundation of circular textiles lies in replacing virgin raw materials with recycled and regenerative alternatives.

Key interventions include:

- Scaling rPET production capacity
- Developing textile-to-textile recycling technologies
- Increasing collection rates for plastic and textile waste
- Encouraging biodegradable fiber innovation

India could establish regional recycling hubs integrated with PM MITRA parks, ensuring reliable feedstock supply.

Pillar 2

Traceable Supply Chains

Future global textile markets will operate on data transparency and digital traceability.

This pillar focuses on:

- Digital Product Passport implementation
- Blockchain-based supply chain tracking
- Fiber-level traceability systems

These tools will enable brands and regulators to verify sustainability claims.

Pillar 3

Low-Carbon Manufacturing

Reducing the carbon footprint of textile manufacturing requires systemic changes across production processes.

Priority areas include:

- Renewable energy adoption in textile clusters
- Water-efficient dyeing technologies
- Electrification of industrial heat processes

Decarbonisation strategies will also improve compliance with emerging carbon disclosure frameworks.

Pillar 4

MSME Inclusion

Because small manufacturers dominate India’s textile ecosystem, circular transformation must include mechanisms that support MSME participation.

Key initiatives include:

- Subsidized ESG certifications
- Shared infrastructure for waste treatment
- Access to green financing instruments

Cluster-based approaches can significantly reduce compliance costs for smaller firms.

Pillar 5

Global Market Alignment

Finally, Indian textile standards must be harmonized with global regulatory frameworks.

This includes alignment with:

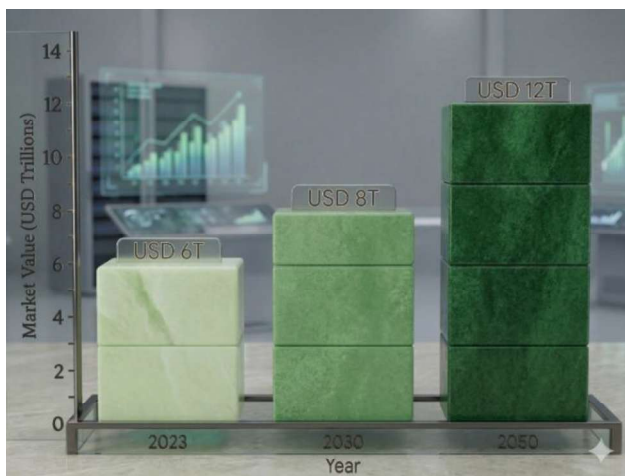
- EU Ecodesign regulations
- Global Recycling Standard (GRS)
- ZDHC chemical management protocols

Such harmonization will enable Indian exporters to access premium markets without regulatory friction.

The 2030 Vision

If these interventions are implemented effectively, India has the potential to position itself as the global leader in circular textile manufacturing, combining scale, cost competitiveness, and sustainability leadership. By aligning industrial policy with circular economy principles, India can transform the narrative of **“Make in India” into “Sustainably Made in India.”**

Circular Fashion Market Growth Projection



Source: Ellen MacArthur Foundation

