

A photograph of a textile factory interior. Large spools of white thread are mounted on a machine, arranged in rows. The spools have blue and yellow patterned caps. The background shows more of the factory structure.

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ROADMAP FOR A SUSTAINABLE TEXTILE HUB

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ACKNOWLEDGEMENT:

We sincerely express our gratitude to the United Nations Environment Programme for entrusting CEE to conduct the study for the Surat cluster and prepare the Roadmap for a Sustainable Textile Hub in India. We are also thankful to team UNEP for guidance and support in drafting this report.

We also acknowledge Ministry of Textiles - Government of India, the South Gujarat Chamber of Commerce and Industry (SGCCI) and South Gujarat Textile Processor's Association (SGTPA) and industries at large, for their invaluable support during this project of. We are also indebted to the reviewers for their comments and valuable insights.

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ABOUT THE ORGANISATIONS

Centre for Environment Education (CEE)

was established as a Centre of Excellence of the Ministry of Environment and Forests, Government of India, in 1984. As a national institution, CEE's mandate is to promote environmental awareness nationwide. CEE develops innovative programmes and educational material and builds capacity in the field of Education for Sustainable Development (ESD). It is committed to ensuring that Environmental Education (EE) leads to action for sustainable development.

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since its inception in 1972, has been the global authority that sets the environmental agenda, promotes the coherent implementation of the environmental dimension of sustainable development within the United Nations system and serves as an authoritative advocate for the global environment. UNEP's mission is to provide leadership and encourage partnership in caring for the environment by inspiring, informing, and enabling nations and peoples to improve their quality of life without compromising that of future generations. UNEP works on delivering transformational change for people and nature by drilling down on the root causes of the three planetary crises of climate change, nature and biodiversity loss, and pollution and waste.

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LIST OF ACRONYMS

APCD	Air Pollution Control Device
BAT	Best Available Technique
BOD	Biological Oxygen Demand
CAAQMS	Continuous Ambient Air Quality Monitoring System
CAGR	Compound Annual Growth Rate
CCD-GoG	Climate Change Department, Government of Gujarat
CEE	Centre for Environment Education
CEMS	Continuous Emissions Monitoring System
CETP	Common Effluent Treatment Plant
CO	Carbon Monoxide
Co2	Carbon Dioxide
COD	Chemical Oxygen Demand
CPCB	Central Pollution Control Board
CTO	Consent To Operate
DGVCL	Dakshin Gujarat Vij Company Limited
ETP	Effluent Treatment Plant
ETS	Emission Trading System
EV	Electric Vehicle
FOGWA	Federation of Gujarat Weavers Association
FOSTTA	Federation of Surat Textile Traders Association
GCPC	Gujarat Cleaner Production Centre
GEDA	Gujarat Energy Development Agency
GDP	Gross Domestic Product
GIDC	Gujarat Industrial Development Corporation
GoG	Government of Gujarat
GoI	Government of India
GPCB	Gujarat Pollution Control Board
HCV	Heavy Commercial Vehicle
HHV	Higher Heating Value
INR	Indian Rupee
KLD	Kilolitre per day
LCV	Light Commercial Vehicle
LEZ	Low Emission Zone
MANTRA	Man Made Textiles Research Association
MLD	Million Litres per Day
MMF	Man-Made Fabric
MoEFCC	Ministry of Environment, Forest and Climate Change
MSME	Micro, Small & Medium Enterprise
MSW	Municipal Solid Waste

NAMP	National Air Quality Monitoring Programme
NCAP	National Clean Air Programme
NDC	Nationally Determined Contribution
Nox	Nitrogen Oxides
PET	Polyethylene Terephthalate
PIL	Pandesara Infrastructure Ltd.
PM	Particulate Matter
PM-MITRA	PM Mega Integrated Textile Region and Apparel
PPE	Personal Protective Equipment
R&D	Research & Development
RDF	Refuse Derived Fuel
RTO	Regional Transport Office
SAMP	State Air Quality Monitoring Programme
SDGs	Sustainable Development Goals
SGCCI	The Southern Gujarat Chamber of Commerce and Industry
SGTPA	South Gujarat Textile Processors Association
SHGs	Self Help Groups
SMC	Surat Municipal Corporation
SOx	Sulphur Oxides
SPM	Suspended Particulate Matter
SSI	Small Scale Industries
STP	Sewage Treatment Plant
TERI	The Energy Resource Institute
TPD	Tonnes per Day
TPH	Tonnes per Hour
TRA	Textile Research Association
TSDf	Treatment, Storage, and Disposal Facility
UNEP	United Nations Environment Programme
WTE	Waste to Energy
WRI	World Resources Institute



GLOSSARY

Chindi

Yarn/Fabric trimmings generated in the units and the market, during the manufacturing process.

Cottage Operations/ Industries

A small manufacturing operation, often run out of a person's home.

Fugitive Emission

The unintentional and undesirable emission, leakage, or discharge of gases or vapours.

Grey Fabric

Unfinished fabric which hasn't been dyed, bleached or processed.

Hotspots

A hotspot is a stage in the life cycle of a product or service that accounts for a significant part of its environmental, social and/or economic impacts.

Low Emission Zone

Low-Emission Zones (LEZs) are defined areas within cities where the use of polluting vehicles is regulated through restrictions or financial charges in order to tackle air pollution, greenhouse gas emissions and congestion.

Non-Attainment Cities

Non-attainment cities are cities which did not meet the national ambient air quality standards, based on the Air Quality data from 2014-2018. Non-attainment cities have been mandated to reduce pollution load of PM2.5 by 20-30 percent by 2024.

Pre-Consumer Textile Waste

Pre-consumer textile waste is waste generated in the textile and garment production process.

Sustainable Textile Hub

Sustainable Textile Hub can be defined as a geographical concentration of textile industries that carry out production/ processing activities while minimising negative environmental and socio-economic impacts, in line with a sustainable and circular textile value chain.

Social Sustainability

Social sustainability is about identifying and managing business impacts, both positive and negative, on people.

Technical Textiles

Technical textiles are engineered products with a specific functionality and have applications across various industries including automobiles, civil engineering and construction, agriculture, healthcare, industrial safety, personal protection etc.

Water Footprint

The water footprint measures the total amount of water used, direct and indirect, in production of goods and services.



EXECUTIVE SUMMARY

In consultation with the Ministry of Textiles, the Government of India, the United Nations Environment Programme (UNEP), India Country Office, conceptualized a study on minimizing the negative environmental and socio-economic impacts of textile hubs in India, with the aim of developing a 'Roadmap for Sustainable Textile Hubs in India'. This first-of-a-kind study was carried out in collaboration with the Centre for Environment Education (CEE) and the textile cluster in Surat, the textile city of Gujarat, was identified for the study.

The textile industry has been crucial to Surat's impressive economic growth through the years. One of India's most progressive textile clusters, the Surat Textile Cluster spans the entire production value chain of the textile industry, from fibre to fabric and apparel. Surat is recognised as the Man-Made Fabric (MMF) capital of India as it contributes to more than 60 percent of the MMF produced in the country, as per the Southern Gujarat Chamber of Commerce and Industry (SGCCI). The city is host to 480 processing units and around 25000 weaving units.

Given the scale of operations and the well-recognised environmental and social impacts of textile production, the need for a coherent set of actions that could support the transformation of the cluster into a 'Sustainable Textile Hub' was identified. A Sustainable Textile Hub is envisioned as a geographical concentration of textile industries that carry out production/ processing activities while minimising negative environmental and socio-economic impacts, in line with a sustainable and circular textile value chain. The units in such a cluster will work together to advance sustainable development strategies and increase innovation and enterprise in the sector. This study is one of the first attempts to adopt a cluster-based approach to identifying gaps that exist in the textile weaving and processing segment with respect to the adoption of sustainable approaches and practices, and to help stakeholders orchestrate actions and devise solutions through the development of a coherent Roadmap.

As part of the study, a baseline assessment was undertaken to analyse the environmental and socio-economic impacts associated with textile production, specifically focused on the weaving and processing sector units and the common infrastructure in the Surat textile cluster. The gaps and opportunities identified through the assessment formed the basis for the development of a 'Roadmap for a Sustainable Textile Hub'. The Roadmap identifies goals and supporting priority actions, and the relevant stakeholders who can drive the transformation of the Surat cluster into a sustainable textile hub. A multi-stakeholder participatory approach was adopted for the development of the Roadmap to enable holistic representation of all perspectives and to secure long-term buy-in from all stakeholders for achieving the sustainability goals.

The Roadmap lays out six ambitious goals for the cluster to achieve by 2030 as agreed by the stakeholders. These goals are also in line with India's Nationally Determined Contributions (NDCs) and the Sustainable Development Goals of the UN's Agenda 2030, and also take into consideration the environmental and socio-economic impacts identified in UNEP's study, 'Sustainability and Circularity in the Textile Value Chain: Global Stocktaking' (UNEP, 2020). The six priority goals are:

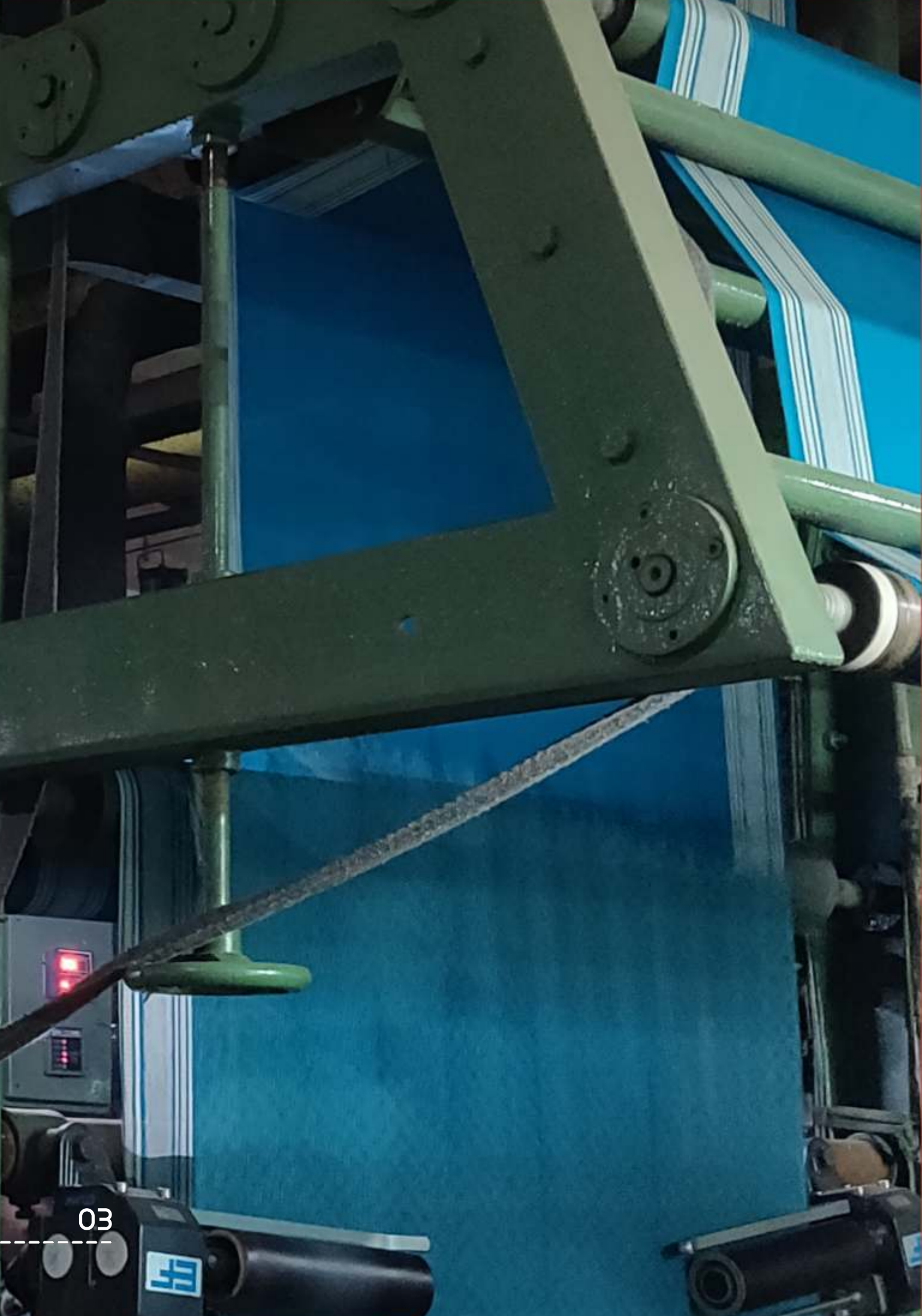
1. To reduce particulate emissions and achieve PM₁₀ concentration of 60µg/m³ as per the national ambient air quality standard in industrial areas by 2030



2. To increase the share of recycled water for industrial uses to 50 percent by 2025 and 100 percent by 2030
3. To reduce dependency on fossil fuels and achieve atleast 50 percent energy from non-fossil fuel-based energy resources by 2030
4. To develop mechanisms for collection, handling, sorting, and reutilisation of 100 percent pre-consumer textile waste by 2030
5. To achieve social sustainability in all systems and processes
6. To promote use of Electric Vehicles (EV) for freight and personnel movement

A highly competitive market and low profit margin on goods were identified as the key factors inhibiting the industry's adoption of sustainable practices. Other serious challenges identified also include inadequate technical expertise, lack of skilled labour, and the use of outdated technology. These findings were also taken into consideration for the development of the Roadmap.

Achieving the goals laid out in the Roadmap within the Surat textile cluster will depend primarily on self-regulatory models, where stakeholders voluntarily participate in adopting the recommended actions. Collaboration between the key stakeholders, institutionalisation of an appropriate mechanism for roadmap implementation, improving availability of data and encouraging data transparency, along with supportive policies, access to finance and a robust monitoring and evaluation framework to assess progress will be critical for the successful implementation of Roadmap 2030. Simultaneously, there is a need to sensitize stakeholders to more ambitious and systems-level actions that will be critical for creating a sustainable and circular textile value chain and garner support for the uptake of such actions by all the stakeholders involved.





Introduction

1



INTRODUCTION

1.1 THE INDIAN TEXTILE INDUSTRY

The Indian textile industry is extremely diverse, ranging from traditional hand-spun and hand-woven sectors to capital intensive, sophisticated mills sector. As the second-largest employment generator after agriculture, the sector is a huge economic force and a significant contributor to India's Gross Domestic Product (GDP). India's export of textiles made up 11.4 percent of all export revenue and accounted for 4 percent of the global trade in textiles and apparel in 2020-21 (Ministry of Textiles, 2022).

The textile industry in India is expected to continue growing on account of an increase in both domestic consumption and exports, as well as an increasing demand for technical textiles, and with support of favourable policies from the government.

Gujarat is home to one of the most thriving textile sectors in the world and contributed 15 percent to India's textile and apparel exports in 2019 (Industrial Extension Bureau, 2020). It is also frequently referred to as the "textile state" of India, with textiles being amongst the state's oldest industries.

1.2 SURAT TEXTILE INDUSTRY OVERVIEW

Surat is the second-largest commercial hub in the state of Gujarat and it is one of the cities slated for development as a smart city under the Smart Cities Mission. According to research by WRI India (2021a), the city will have the fastest economic growth in the world between 2019 and 2035. It is known as the Man-Made Fabric (MMF) capital of India due to the scale of its synthetic fabric producing industry.

Textile industries make up over 67 percent of all industries in the Surat Municipal Corporation (SMC) region. Textile traders from the Surat Textile Market play a central role in the Surat Textile Cluster. The traders are involved in every stage of production as they provide job work contracts to the textile production units based on the orders they receive, and are also responsible for further distribution and sale of products.

Units in the Surat Textile Cluster carry out a wide range of activities under the textile value chain such as weaving, knitting, dyeing, printing, jari (silver) making, and embroidery, and are supported by other industries such as chemicals & auxiliary, and machinery manufacturing for the

textile industry. Surat is also rapidly becoming a centre for apparel and garment businesses with a mega textile park being proposed between Surat and Navsari, under the PM Mega Integrated Textile Region and Apparel (PM-MITRA) scheme. Another link in the value chain, slowly establishing itself in Surat is the spinning of yarn from virgin or recycled material. The city's textile market is also expanding quickly, and as identified in the baseline study, there are currently 185 textile markets and about 58600 textile shops. There is, therefore a great need and opportunity for the adoption of sustainable practices by the actors involved in each of these activities at different stages of textile production.

The sector is largely unorganised and

consists of rapidly expanding MSMEs owing to the fiscal advantages in terms of incentives and subsidies. Cottage industries have also traditionally formed an integral part of the cluster. A sizable portion of the city's population receives income and employment from the complex network of micro, small, medium, and large enterprises that make up Surat's textile sector. The main export markets for yarn and grey fabric produced in Surat are Asian nations while the Middle East is the main export market for finished textiles products.

The Surat Textile Cluster is made up of twelve sub-clusters which are spread out within and outside the city's geographical boundary as detailed in Figure 1, with newer sub-clusters likely to emerge soon.



Figure 1: Map of Surat District with geographical representation of Surat Textile Cluster

Even as it continues to grow, the textile sector in Surat faces multiple challenges including:

- Haphazard development due to lack of systematic planning
- Increase in production cost due to rising cost of labour and power
- Lack of skilled workforce
- Use of outdated technology

- Majority of the transactions carried out on a credit basis

Despite these challenges, the city plays a significant role in the manufacture of synthetic fabrics. According to information provided by the Southern Gujarat Chamber of Commerce and Industry (SGCCI), Surat produced around 1.5

million metric tonnes (MT) of yarn and 14600 million metres of fabric in 2020. SGCCI also forecasts a growth rate of 10 - 12 percent for the man-made fabrics industry in Surat in the near future. Table 1 provides a snapshot of key statistics relating to the number of units and production metrics of the cluster.

Snapshot of Surat Textile Cluster

Total No. of Weaving Units	25,000
Total No. of Power Looms	6,35,000
Total No. of Water jet Looms	64,000
Total No. of Rapier Looms	22,000
Total No. of Jacquard Looms	5,000
Total No. of Air-jet Looms	2,000
Total No. of Process houses	480
Total Embroidery Machines	1,20,000
Total Number of Warp Knitting Machines	1,200
Total Number of Circular Knitting Machines	3,500
Total No. of Textile Markets	185
Total No. of Textile Shops	58,600
Total Yarn Production per Year	1.50 million MT
Total Yarn Sales per year	115 billion INR
Total Fabric Production per year	14,600 million metres
Appx. Sale value of fabric produced in a year	800 billion INR
Total Employment by Weaving Industry	1 million people
Total Employment in Textile Sector in Surat	1.5 million people
Estimated number of Entrepreneurs in the Textile segment in Surat	1.50 lakh Individual
Annual Growth Rate	10 to 12 percent

Table 1: Surat Textile Cluster; Source: SGCCI and FOGWA (2021)

1.3

About the Study and Methodology

In consultation with the Ministry of Textiles, the Government of India, the United Nations Environment Programme (UNEP), India Country Office, conceptualized a study on minimizing the negative environmental and socio-economic impacts of textile hubs in India, with the aim of developing a 'Roadmap for Sustainable Textile Hubs in India'. This first-of-a-kind study was carried out in collaboration with the Centre for Environment Education (CEE) and the textile cluster in Surat was identified for the study.

Given the scale of operations in Surat and the well-recognised environmental and social impacts of textile production, the need for a coherent set of actions that could support the transformation of the cluster into a 'Sustainable Textile Hub' was identified. A Sustainable Textile Hub is envisioned as a geographical concentration of textile industries that carry out production/ processing activities while minimising negative environmental and socio-economic impacts, in line with a sustainable and circular textile value chain. The units in such a cluster will work together to advance sustainable development strategies and increase innovation and enterprise in the sector. The study consisted of two main elements, a baseline assessment followed by the development of a Roadmap, as detailed in the sections below. This

study is one of the first attempts to adopt a cluster-based approach to identifying gaps that exist in textile manufacturing with respect to the adoption of sustainable approaches and practices, and to help stakeholders orchestrate actions and devise solutions through the development of a coherent Roadmap. A multi-stakeholder participatory approach was adopted for the development of the Roadmap to enable holistic representation of all perspectives and to secure long-term buy-in from all stakeholders for achieving the sustainability goals.

UNEP's report on Sustainability and Circularity in the Textile Value Chain identifies textile production as a major hotspot for environmental and socioeconomic impacts, with impacts on climate, human health, ecosystem quality, and social security (UNEP, 2020). On the other hand, when compared to other stages of textile value chain, yarn and fibre production have significantly lower impacts and hence was not identified as a major hotspot. However, with the increase in the water jet looms in Surat, the need for water and water treatment is rising and as a result, for this study, weaving and textile processing were considered as the hotspots and impacts of their activities were studied. Additionally, as the city predominantly processes polyester fibre, the focus of the study was limited to studying the impacts associated with

MMF manufacturing processes.

1.3.1 Baseline Assessment

The methodology for the baseline assessment included both primary and secondary research. A desk-based literature analysis was first conducted to identify environmental and socio-economic impacts associated with textile production, specifically focused on the weaving and processing sector units and the common infrastructure in clusters. Gaps and opportunities were identified based on the secondary research, which were then validated by visiting units in the Surat cluster. A total of 25 textile units (as detailed in Table 2) in Pandesara, Sachin, Palsana, Kosamba and Kadodara were visited for the baseline study over a course of 4-6 months in 2021, with an additional inclusion of 6 Common Effluent Treatment Plant (CETPs).

Additionally, stakeholder consultations were also conducted to strengthen the baseline assessment. Mapping of the stakeholders for the consultations was achieved with the help of local partners. The stakeholder pool consisted of experts and leaders from various value chain segments, industrial associations, individual consultants, Pollution Control Boards, local municipal corporation, CETP officials, technology providers, research institutes and agencies working on other textile-related initiatives. The consultations were instrumental for deriving recommendations for bridging the gaps that were identified and validated.

Number of Processing Houses Visited	17
Number of Weaving Units Visited (Power looms, Water jet, Air jet, Rapier, & Jacquard looms)	8
Number of CETPs visited	6

1.3.2 Roadmap Development

The gaps and recommendations identified during the baseline study served as the foundation for the development of a 'Roadmap for a Sustainable Textile Hub'. The Roadmap lays out six ambitious goals for the cluster to achieve by 2030 to progress towards a sustainable textile hub. These goals are also in line with India's Nationally Determined Contributions (NDCs) and the Sustainable Development Goals of the UN's Agenda 2030, and also take into consideration the environmental and socio-economic impacts identified in UNEP's study, 'Sustainability and Circularity in the Textile Value Chain: Global Stocktaking' (UNEP, 2020). A Steering Committee was formed under the Chairmanship of Hon'ble Commissioner, Surat Municipal Corporation, to guide and oversee the development of the roadmap. Additionally, six Working Committees were formed based on the six impact areas identified in the baseline assessment.

The recommendations from the baseline study were further prioritised through multiple stakeholder consultations and discussions with the Steering and the

Working Committees to develop the six goals and list of priority actions under each goal. The goals also integrate any existing plans of the local municipal corporation. Each goal is supported by

actions that can be tracked to assess progress in the short, medium and long term.

UNEP's Approach to a Sustainable and Circular Textile Value Chain

UNEP aims to provide strategic leadership and encourage sector-wide collaboration to accelerate a just transition towards a sustainable and circular textile value chain, while supporting sound management of chemicals. UNEP has adopted a value chain approach to advancing sustainability and circularity in the textile sector. Analysing the value chain rather than just the supply chain increases the range of stakeholders to include all those with influence or engagement in the textiles sector. This includes policymakers, financial institutions and non-governmental organizations (NGOs). Taking a value chain approach also implies looking not only at the physical processes (such as farms or factories), but also at the way products are designed, promoted and offered to consumers.

For a textile product, the value chain starts with fibre production. This can be sourcing natural agricultural materials and their subsequent processing to extract the fibre (e.g., cotton), or crude oil extraction and the manufacture of chemicals from which synthetic fibres are made (e.g., polyester), or a combination of both. Subsequent manufacturing stages involve spinning the fibres into yarn, and knitting, weaving or bonding the fibres in some other way into fabric. The fabric is then subjected to chemical and/or mechanical processing (known as finishing) to produce a textile with the desired properties (e.g., softness or water repellence). The next step in the value chain involves cutting and sewing the textile into the product, followed by getting the product to the user (distribution and retail). After its first use, the textile product can be used again (e.g., donated second-hand clothing) or it can be recycled to a different use.

The aim of circularity is to shift the “take-make-dispose” linear value chain into a circular system. This means the materials are not lost after use, but remain in the economy, circulating as long as possible at the highest possible value.

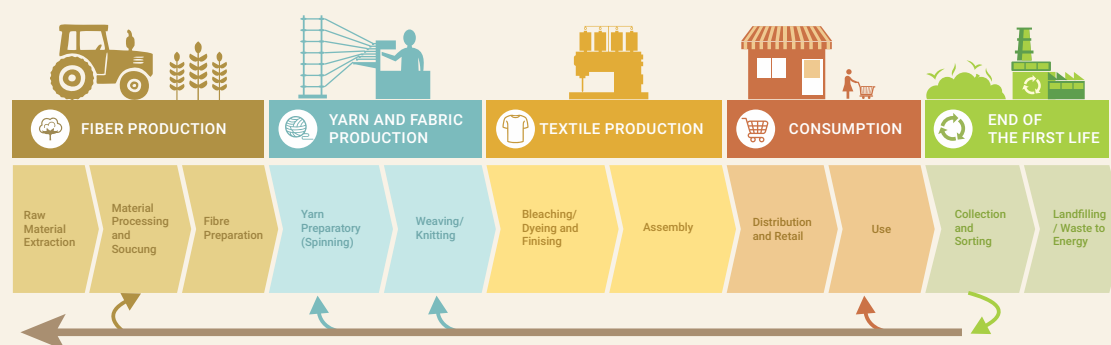


Figure 2: Linear Representation of Activities Along the Textile Value Chain

Source: UNEP (2020)

Read more about UNEP's textile work here: <https://www.unep.org/explore-topics/resource-efficiency/what-we-do/sustainable-and-circular-textiles>.



Baseline Assessment

2



KEY FINDINGS FROM BASELINE ASSESSMENT

The findings from the baseline assessment, the impact areas identified for the Surat textile cluster, and the gaps and recommendations under each impact area, are described in detail in the following section of the report. These recommendations have been identified based on their overall environmental and socio-economic impact.

2.1

Air Quality

Surat is one of the non-attainment cities under the National Clean Air Programme (NCAP) (MoEFCC, 2019). Non-attainment cities have been mandated to reduce pollution load of PM_{2.5} by 20-30 percent by 2024 (MoEFCC, 2021). Ten locations have been identified in Surat, as part of the State Air Quality Monitoring Programme (SAMP) and National Air Quality Monitoring Programme (NAMP), where manual air quality monitoring is carried out. However, there is a lack of real-time data on air quality, as currently only annual averages are published. Two sensor-based continuous monitoring stations have also been installed; however, the reliability of their data is questionable.

Textile units require utilities like steam and thermic fluid for various processes. Process equipment such as boilers and

thermopacks are fuelled by fossil fuels, predominantly coal, to generate these utilities. Combustion of coal and other solid fuels, such as wood, releases flue gas that contains Particulate Matter (PM) and gases like Carbon Monoxide (CO), Carbon dioxide (CO₂), Nitrogen Oxides (NO_x) and Sulphur Oxides (SO_x). Industries contribute to around 51 percent of PM₁₀ concentrations in winter and about 37 percent in summer, according to the source apportionment study carried out for Surat City (TERI, 2021).

Textile units use two types of coal: domestic coal with a low calorific value and a higher PM content, and imported coal with a higher calorific value but a higher cost. Local coal availability is determined by government allotment, whereas imported coal can be sourced from the market through the assistance of private agents. During industry visits and stakeholder engagements, it was discovered that units frequently blend the two types of coal to feed the process equipment. The equipment, however, is not intended for such a fuel combination. Additionally, due to the rising cost of coal post the COVID-19 pandemic, other solid fuels such as wood have been increasingly used in the fuel mixture.

The Central Pollution Control Board (CPCB) has established boiler emissions

criteria based on the capacity of boilers. Boilers with a capacity of less than 2 tonnes per hour (TPH), sometimes known as baby boilers, have higher emissions limits while boilers with a capacity greater than 2TPH are subject to stricter regulations. According to a study by WRI India (2021b), baby boilers made up roughly 52 percent of all boilers surveyed in Surat's Industrial Zones.

It was also discovered that some units

utilise textile waste, known as "*chindis*", and other materials as fuel to reduce costs, due to the unpredictable cost and availability of coal. Uncontrolled burning of these materials emits toxic fumes into the environment. Additionally, the burning of *chindis* is considered unauthorized, as they are not listed in the type of fuels that can be used by units, as specified by the Gujarat Pollution Control Board (GPCB).



Figure 3: Stack Emissions from non-complying Textile Units

All units are required to obtain a Consent to Operate (CTO) certificate from the GPCB which specifies the type and quantity of fuel the unit can use. The CTO also specifies the pollution control devices, known as the Air Pollution Control Devices (APCDs), that units must install in order to meet the emission standards set by GPCB and CPCB. A research by Duflo et al., (2013) showed

that 59 percent of the units in the Surat Industrial Zone were emitting more than the recommended level. One of the major issues identified in this study was inefficient operation of APCDs. The efficient usage of these devices requires trained labour and frequent maintenance, which were also identified as challenges in the baseline assessment carried out as part of this roadmap study.

This was validated in the WRI India (2021b) study, where analysis of 447 units in Surat's Industrial Zones revealed that the majority of units struggle to maintain and calibrate these devices due to a lack of resources and knowledge. Under the status quo, the particulate emission would double by 2030, underscoring an urgent need for action (WRI India, 2021b).

As seen in Figure 4, in 2018-2019, an alarming level of Particulate Matter (PM10) concentration was observed in industrial areas within city limits, raising

concerns for citizens' health. Pandesara, Udhana, Ved Road, Bhetsan, Sachin, and Katargam were recognised as areas with high industrial emissions (WRI India, 2021a). The high concentrations can also be attributed to the lack of green cover in industrial areas, which has reductive effect on air-borne PM concentrations (Diener and Mudu, 2021). Of the 65 textile mills that were functioning within the city limits, roughly 55 were willing to relocate their units outside of the boundaries and had asked the government for land measuring about 100 hectares. This proposal is still under review.

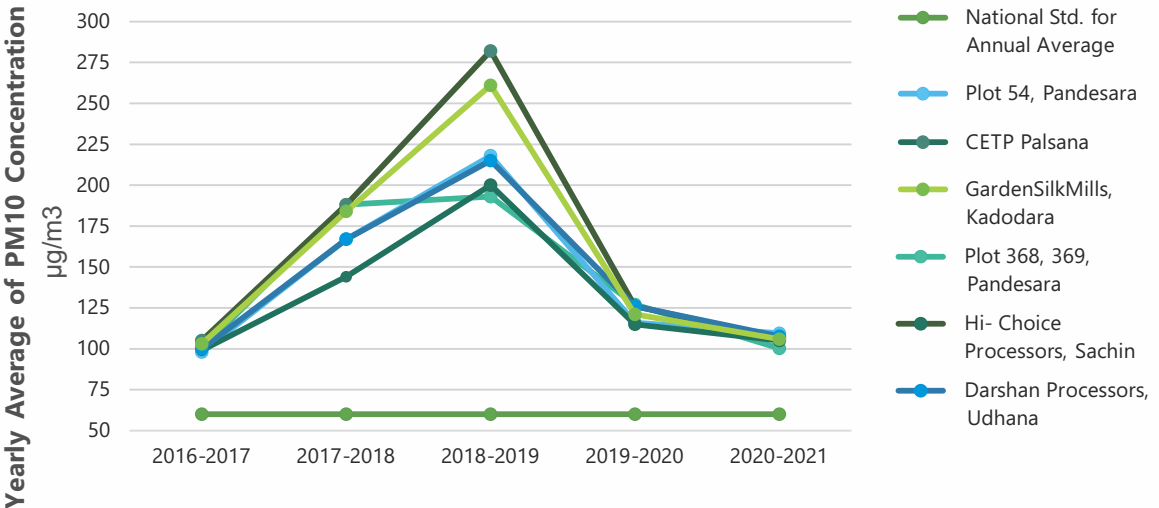


Figure 4: PM10 Concentrations at Different NAMP & SAMP Stations
(Source: GPCB, 2021)

Case Study: Emission Trading Scheme (ETS)

A pilot Emission Trading Scheme (ETS) based on the cap-and-trade mechanism was introduced in Surat in 2019 to address the issue of rising pollution. The scheme was formulated by researchers from the Economic Growth Center at Yale University, the Energy Policy Institute at the University of Chicago (EPIC) India, and The Abdul Latif Jameel Poverty Action Lab (J-PAL) in close consultation with the Gujarat Pollution Control Board. This scheme invited voluntary participation from the units, ranging across different sectors such as Chemicals (i.e., dye intermediates), Paper, Sugar and Distilleries, and Textiles; and participating units were directed to install Continuous Emissions Monitoring Systems (CEMS). As part of the scheme, each unit is assigned permits for

Suspended Particulate Matter (SPM) depending on the permitted emission load as listed in the unit's CTO. Units that emit more than the allowed load are required to procure permits from the ETS market, which runs on a weekly basis. Out of a total of 317 units that installed CEMS and participated in the study, a treatment group of 162 units was connected to the new emissions market (Greenstone et al., 2022). When compared to units in the control group, which continued to operate under the status quo, it was discovered that pollution in units in the treatment group decreased by 24 percent (Greenstone et al., 2020; Clean Air Markets, 2022).

A summary of gaps and recommendations with regards to improving air quality in Surat Textile Cluster is provided in Table 3.

Gaps Identified	Recommendations
Inefficient operation of Boiler-APCD Combination	Upskilling of operators to perform routine maintenance and increase overall efficiency
	Develop toolkit for self-assessment of APCD capacity and to increase operational efficiency
	Install combustion control systems in boilers
Use of unauthorized fuels for boiler feed	Vigilant monitoring and inspections to tackle use of unauthorized fuels
Absence of reliable air quality data	Strengthen the air quality monitoring network
Increasing fuel cost and lack of consistent availability of fuel	Install community boilers in new industrial parks for efficient use of fuel
	Introduce Refuse Derived Fuel (RDF) and other alternative fuels like biomass briquettes
Lack of green cover in industrial areas	Increase peripheral green cover around industrial estates
Non-compliance to emission standards	Expand the pilot Emission Trading Scheme (ETS) to all eligible units

Table 3: Air Quality: Gaps & Recommendations

2.2

Water and Chemicals

Textile processing units and weaving units that deploy water jet looms are highly water intensive. Wet processing uses large quantities of water and also generates the most wastewater of all the processes used in textile manufacturing. 140–200 litres of water are needed to treat 1 kilogram of fabric in textile dyeing units (Central Pollution Control Board, 2015). Due to the increase in water jet looms, there is also a rise in the water demand from the weaving units. Data from SGCCI indicates that there will be a 60 percent rise in the number of water jet looms by 2025, with 64,000 water jet looms currently operational in the cluster. This suggests a significant rise in water demand and warrants immediate measures to strengthen water efficiency measures in the cluster.

Large and medium-sized companies have already established and are operating Effluent Treatment Plants (ETPs) within their units for partial or complete water treatment with the goal of internally recycling it. Different types of residual chemicals, such as auxiliary chemicals, binders, colourants, solvents, and finishes, are present in industrial effluent. The effluent from these internal ETPs and other industries is then treated at the CETPs and the treated effluent from the CETPs subsequently flows into a network of natural creeks that pass through various regions of the city, and finally enter the Arabian Sea, with little chance of being recycled. As per the baseline study, CETPs charge their members an average

treatment cost of Rs. 13.61 per kilolitre per day (KLD) of wastewater. Large clusters with majority textile processing units have dedicated CETPs, however a few clusters do not possess CETPs. Units in such areas are mandated to have ETPs and discharge treated effluent into the SMC drains. However, no monitoring mechanism is in place to check for illegal discharges through SMC drains.

With the exception of industrial parks created particularly for weaving units, both processing and weaving unit effluents currently flow to the same CETPs. The effluent from weaving units, however, is easier to treat and hence recycle, because it primarily consists of oil and grease that are added to the fibre during the spinning process. Of late, the cost of chemicals required for treatment of wastewater has increased, making water treatment more expensive. In order to reduce costs, units are resorting to using chemicals that are hazardous and less expensive, making treatment more complex. Thus, to enable maximal recycling with the lowest possible cost of recycling, the weaving clusters are therefore calling for CETPs exclusively for weaving units. Currently only 2 independent CETPs are commissioned in Surat to cater to wastewater from weaving units. One of the weaving cluster's CETP adheres to Zero Liquid Discharge (ZLD) regime.

In Surat, cotton processing has significantly increased after COVID-19. Disperse dyes make up around 75 percent

of the dyes used in Surat; however, the usage of reactive dyes is rising as cotton processing intensifies (Source: Pandesara Infrastructure Ltd. (PIL), 2020). Reactive dyes used in the processing of cotton are difficult to remove from effluent, in contrast to disperse dyes used in the treatment of synthetic materials (Pereira and Alves, 2012; Saini, 2017). According to estimates, 0 - 10 percent of disperse dyes used is lost to the effluent, whereas losses of reactive dyes range between 10 - 50 percent (Saini, 2017). High concentration of reactive dyes in the unit's effluent increases the difficulty of treatment, leading to discharge of coloured effluent into the waterbodies.

Additionally, there is a dearth of knowledge regarding the ideal quantity of chemicals and dyes that are required for various processes, which results in their excessive usage and increased losses in wastewater. This raises the cost of production as well as increases the load on CETPs. Building the skills of workers handling chemicals and dyes and equipping them with such knowledge is necessary, as is the implementation of an effective chemical management system.

Regular audits at CETPs ensures that they function as per the GPCB's guidelines. However, according to industry sources, certain cottage units and unregistered units illegally discharge wastewater into the streams, posing a major harm to the marine ecosystem.

While units outside of the city limits primarily rely on abstracted groundwater to meet their water needs through unmetered self-supply, those inside the city limits use water provided by SMC.

According to the baseline assessment, around 450 Million Litres per Day (MLD) of water is currently being consumed by the textile cluster. However, the number is imprecise due to a lack of data and accurate metering in units.

Such excessive water use puts strain on the existing water resources and significantly raises the cost of textile production. According to a Surat Municipal Corporation circular in force as of April 1, 2015, non-water-based enterprises such as power looms receive water at a rate of Rs. 15/kl, whereas processing and dyeing units located inside city limits receive water at a rate of Rs. 27/kl (Surat Municipal Corporation, 2015). In comparison to other sources, ground water abstraction fees range from Rs. 1/kl to Rs. 5/kl, making it significantly less expensive.

SMC has launched a programme to provide tertiary treated sewage water for industrial usage in an effort to reduce the dependence on fresh water. Currently, SMC recycles 319MLD of treated sewage, of which 160MLD is supplied to Pandesara and Sachin clusters at a cost of Rs. 28.58/kl (SMC, 2021; Desai, 2021). The water recycling model at Surat Cluster is shown in Figure 5.

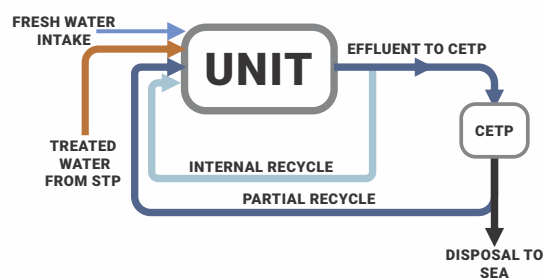


Figure 5: Model of Water Recycling in Surat

Processes like weight reduction, washing of synthetic textiles, etc. release microplastics into the water. Numerous studies have investigated the fate of microplastics in domestic wastewater (Prata, 2018; Bui et al., 2020; Ramasamy, Aragaw and Balasaraswathi Subramanian, 2022), however, only a small subset of research investigates the release of microfibres from the wastewater treatment plants in the textile processing sector. While 95-99 percent of these microplastics are removed during wastewater treatment, the concentration in sludge is still unclear, according to studies by Zhou et al., (2019) and Xu et al., (2018). Analysing and researching the fate of microplastics removed from industrial wastewater during treatment thus becomes necessary.

Case Study:

Water Footprint

The water footprint is the measure of the amount of water used to produce the goods and services we use. The water consumption for the production of synthetic fibres is significantly lower (about 1/10) compared to cotton fibres (Nayak, Panwar and Nguyen, 2020). The water footprint can evaluate both direct and indirect water use of a process, product, company or sector and can include water consumption and pollution throughout the through the complete life cycle.

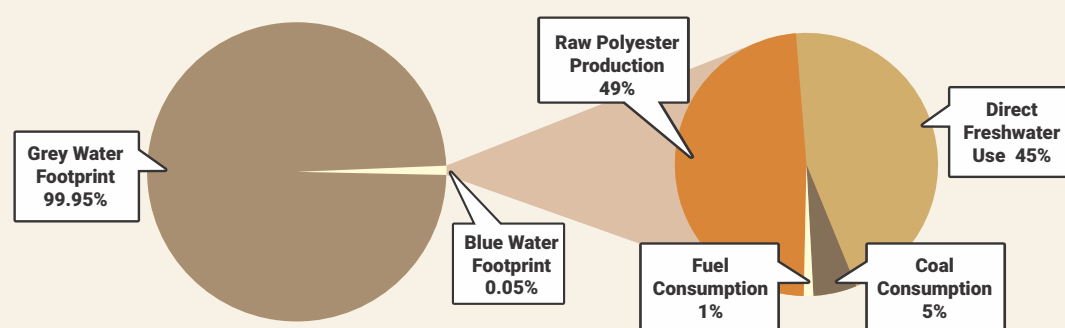


Figure 6: Water Footprint Sample Textile Processing Unit in Surat

Source: Calculations from Water Footprint Implementation

⁶<https://www.waterfootprintimplementation.com/>

A preliminary water footprint assessment, performed with the data from a textile processing unit in Surat, is shown in Figure 6. Production of polyester, thermal and electrical energy generation account for indirect water use along with water assumed to be used for dilution of pollutants. Wastewater resulting from processing of textiles accounts for more than 98 percent of polyester's total water footprint (Freitas, Zhang and Ruth, 2017). Enhancement of wastewater treatment at the industrial level would contribute to the reduction of organic matter loads (Chemical Oxygen Demand (COD) and Biological Oxygen Demand (BOD)) in effluents and therefore decrease polyester's grey and overall water footprint. A guide to calculations and assumptions used for this assessment is available in Annexure 2.

A summary of gaps and recommendations with regards to water and chemicals use is provided in Table 4.

Gaps Identified	Recommendations
Extensive use of fresh water	Support SMC's initiative by promoting use of treated sewage water to meet water demand of industries
	Promote the use of recycled water over fresh water by providing incentives
	Gradually restrict use of groundwater for industrial use
	Promote maximum recycling of treated effluent from CETPs
	Perform water audits to identify sources of water loss, minimize wastage and promote internal recycling
Lack of accurate metering	Ensure all sources of waters in units, including groundwater are metered and water use data is being recorded accurately
Release of excess chemicals and dyes from units	Optimise chemical use through skilling and technology adoption
	Gradually replace reactive dyes with eco-friendly/ natural dyes to increase efficiency of water treatment at CETPs
	Adopt Zero Discharge of Hazardous Chemical (ZDHC) Initiative
Requirement for additional water treatment infrastructure	Support development of CETPs and associated critical infrastructure
Unauthorised discharges in creeks by unregistered and cottage units	Penalise units and connect them to the nearest available CETP network

Table 4: Water & Chemicals: Gaps & Recommendations

2.3

Energy Efficiency and Clean Energy

Textile manufacturing processes are highly energy intensive. For instance, energy cost accounts for 10 percent of the total manufacturing cost in textile dyeing units and these units have a 15-30 percent energy saving potential (SIDBI, 2016). The principal forms of energy used in a typical textile unit are electricity, natural gas, domestic and imported coal, diesel, and wood.

In 2019, as per data from Dakshin Gujarat Vij Company Limited (DGVCL) and Torrent Power (as provided by WRI), the industrial sector in Surat consumed around 345 million units of electricity. Due to increasing production, energy-intensive operations, inefficient usage, and the use of ageing equipment, there is a growing demand for energy in the textile sector units. Additionally, units in the cluster continue to use outdated and energy-intensive technologies owing to a lack of knowledge about new technologies, a scarcity of domestic machinery manufacturers, and shortage of trained labour.



Figure 8: Steam Leak from Piping

Although the trend for import of textile machinery has been on the decline in recent years, as seen in Figure 7, there is still a significant demand for imported machinery in the cluster. This places an additional burden on the units, both on account of increased expenditure and lead time for delivery of machinery.

The Bureau of Energy Efficiency (2017) also reported that the cluster consumed 378600 tonnes of coal in 2016-17. Process houses store coal to meet the demand for at least one week to account for any disruptions in supply. This holds

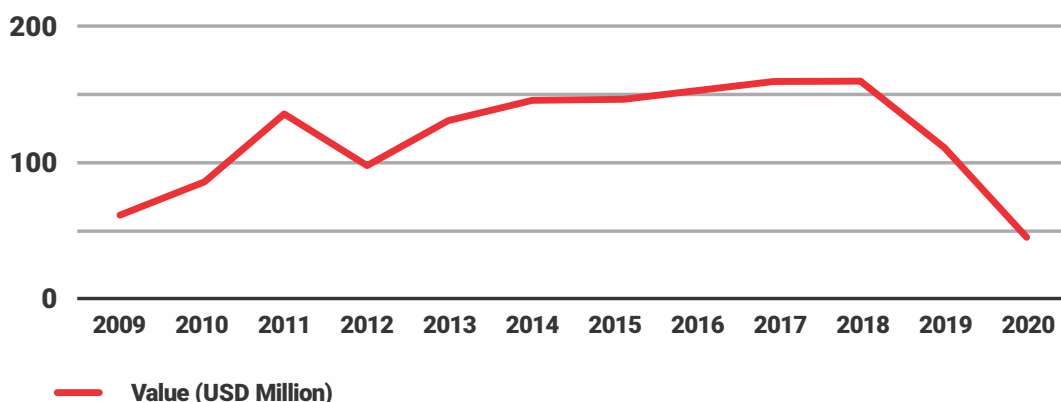


Figure 7: Textile Machinery Import Value Trend
Source: connect2india.com, 2021

true especially during monsoons as availability of coal in the market is reduced and prices inflate. However, such storage facilities generate a lot of heat and are susceptible to fires. To avoid fires, water is sprayed on these piles, which increases moisture content in the coal and leads to increased heat loss during combustion, thereby resulting in increased consumption of coal.

Although the total steam demand in textile units is not very high, the locations within the units where steam is required are widespread leading to losses due to thermal radiation and leakages in the steam network.

Recovery of waste heat can have a significant impact on reducing overall energy consumption. For instance, in most textile units, flue gas from boilers at a temperature of about 180°C is released into the atmosphere. However, a few units have installed economisers and/or air preheaters to recover waste heat. Another example of an effective heat recovery measure was observed at one unit, where condensate is recovered and mixed to preheat boiler feed water, thus helping to reduce both energy and water consumption.

While stakeholders in the cluster recognised the importance of investments in energy-efficiency measures, firms currently lack the requisite in-house technical competence to find and implement efficiency improvements, as well as the financial means to recruit external experts. Concerns about the payback period for the energy efficiency investments also act as a deterrent for adoption of these measures.

The increasing cost of coal and power is a key driver for industries to invest in energy efficient technologies and renewable energy. However, on-site renewable energy is frequently constrained by space; for instance, the number of solar panels that may be installed on a factory roof or on a property is limited. The facilities must also be structurally adequate in order to install the panels. Also identified during the baseline assessment, presence of high load of pollutants like PM10 in the air in the industrial zones leads to soiling of solar panels. Soiling of solar panels reduces performance and requires frequent cleaning, which deters units from investing in solar energy. An alternative would be for industries to invest and obtain renewable energy from off-site sources for their on-site use through open access and energy banking mechanisms. However, high transmission charges were found to be one of the key reasons that such initiatives have failed to gain momentum.



Case Study:

Steam House

Steam House⁷, a first-of-its-kind-company in India, provides 'steam as a utility' through a centralised facility to more than 50 chemical units in Sachin GIDC at Surat, which are connected through a steam grid of 8 kms of insulated pipelines. The state-of-the-art technology and centrally monitored steam generation system ensures compliance with emission standards and improves fuel efficiency, when compared to steam generation at individual units. Additionally, community boilers also offer units a cost-effective and safe alternative to onsite steam generation.



⁷ <https://steamhouse.in/>

A summary of gaps and recommendations with regards to promoting energy efficiency and clean energy adoption is provided in Table 5.

Gaps Identified	Recommendations
High energy consumption due to archaic technologies and inefficient operation	Accelerate adoption of energy efficient technologies
	Train operators to efficiently operate equipment
High lead time and cost for machinery import	Develop partnerships with international agencies for technology transfer to boost domestic machinery manufacturing
Low investment in solar energy due to soiling of panels, space constraints, and high transmission costs relating to offsite generation.	Incentivize self-cleaning solar panel setup for industries
	Promote development of group captive solar parks
	Promote open access and energy banking mechanisms
Heat loss	Promote waste heat recovery and measures to prevent heat loss
	Perform thorough energy audits, to identify causes and implement adequate measure

Table 5: Energy: Gaps & Recommendations

2.4

Solid Waste

Solid Waste generated in textile units comprises of packaging waste, fabric scraps, trimmings, ETP sludge, bottom and fly ash and waste containers. GPCB identifies three types of hazardous waste from textile units, namely, ETP/CETP Sludge, used oil and discarded containers/barrels. GPCB mandates that the quantity of such wastes has to be recorded and they must be disposed at authorised Treatment, Storage, and Disposal Facilities (TSDF)

4100/MT. Units in Surat Cluster incur additional charges on account of transportation of waste to the Bharuch TSDF. To avoid such costs, some of the CETPs have set up technologies to dry the sludge generated and send it for co-processing to the cement industry.

Similarly, bottom and fly ash collected from boilers and thermic heaters is supplied to brick kilns for making pavement blocks. However, due to the absence of an authorised mechanism for



Figure 10: An informal facility in the Surat Cluster Managing Textile Waste

sites.

Disposal of hazardous waste is a challenge for the Surat region as there are no hazardous waste treatment and disposal sites present in the region. The nearest TSDF facility for Surat is in Bharuch, which is approximately 75kms from Surat. The disposal fee charged by TSDFs can range from Rs. 3100/MT to Rs.

collection of such wastes, there is a lack of transparency in the use and disposal of this waste.

Textile waste such as fabric trimmings, yarn waste, cut-pieces, etc are not classified as hazardous waste and hence their disposal is governed by the Solid Waste Management Rules. According to SMC Officials, in 2019, textile units and



Figure 11: Unauthorized Dumping of Textile Waste

markets generated about 200 tonnes per day (TPD) of waste. Based on stakeholder consultations, it is estimated that around 70 percent of this waste is generated by the textile markets, while the processing and weaving units contribute to the remaining 30 percent. The waste from processing units is contaminated with chemicals and other processing agents, while that from traders and weavers is cleaner.

The handling of textile waste is carried out by waste collectors in the unorganised sector. There is a lack of transparency in the process and the fate of the collected waste remains unknown. In such informal channels, all types of textile wastes are mixed, thus reducing their potential for reusability and making it economically non-viable. This has led to illegal methods of disposing such waste, including using these as fuel or selling the waste to roadside cottage units for making other plastic products. There is an immediate need to develop regulations for proper

collection, sorting, reuse and scientific disposal of waste. This would not only help improve the surrounding environment but also generate a market for waste.

Currently, only a few Self-Help Groups (SHGs) operate to downcycle chindis to products like rope, mattress, etc. It was also observed that most chindi collected by the local municipal corporation is sent to landfill. Of the total Municipal Solid Waste (MSW) burned in the Surat city, 9 percent is textile waste (WRI India, 2021b).

One Waste to Energy (WTE) plant, with a capacity of 10 TPD that utilises the fabric leftovers and uses gasification process to generate steam is currently operational in the Surat Textile Cluster. An 11.5MW WTE plant is also under planning with a capacity of 150 TPD of waste for the use of shredded textiles (SMC, 2022). Although WTE plants can be a temporary measure for dealing with textile waste, options for upcycling and textile-to-textile recycling of such wastes need to be

Case Study:

PET to fibre

Approximately 450 tonnes of Polyethylene Terephthalate (PET) bottles are being recycled to fibre in Surat, every day. Bales of compressed PET bottles are transported from different parts of the country and processed to manufacture filament and staple fibre which is used as filling material for cushions and pillows, or used by spinners to make yarn for converting into fabrics for use in



Figure 12: Recycling of PET to Fibre

A summary of gaps and recommendations with regards to handling of solid waste is provided in Table 6.

Gaps Identified	Recommendations
Improper handling of textile waste	Classify types of textile waste based on sources of generation
	Develop mechanism for authorizing waste collectors to collect textile waste and issue guidelines for proper handling and disposal of textile waste
	Develop collection and sorting mechanisms to enhance reusability of textile waste
	Study possibility of developing waste valorization techniques like waste to energy plants as temporary measures
	Introduce Extended Producer Responsibility for pre-consumer textile waste
	Promote upcycling of textile waste
	Promote use of recycled fibres in production
No organized mechanisms to dispose coal ash (bottom and fly ash)	Authorize waste collectors to procure the waste and supply to co-processing units

Table 6: Solid Waste: Gaps & Recommendations

2.5

Social Sustainability

The textile industry in Surat provides employment to semi-skilled, skilled and even unskilled workers, who later develop their skills and move up the work ladder through years of labour. As part of the baseline assessment, a skill gap analysis study was conducted in 385 units spread across the Surat Textile Cluster - the study revealed that 78 percent of unit owners /personnel in charge believe that proper training can bridge the skill gap and increase operational efficiency of the unit. However, only 29 percent of the units are willing to train the existing staff due to concerns related to workforce retention. For the purpose of skilling labourers, the government has established institutions, but they are not very well-equipped.

Majority of workers begin working in the units as unskilled labours and hence regard safety matters as secondary to work. It was noticed during site visits that

the prime reasons for accidents in textile units included inadequate housekeeping, ergonomical issues, lack of Personal Protective Equipment (PPEs), absence of fire safety equipment, unskilled workers and poor layout. Some manufacturers are now enhancing safety awareness through training sessions including periodic safety drills and have also installed fire safety mechanisms such as firewater systems and public announcement systems. However, despite the efforts, workers fail to observe these measures, making the workplace unsafe. Practices such as absence of safety shoes while working in the facility and safe handling of chemicals and auxiliaries were also observed.

Facilities within the city limits face a massive shortage of storage space. The floor area is often seen occupied by containers with processed fabric waiting to be packed and sent to the market. This



Figure 13: Storage of Goods on the Production Floor

restricts free movement and adds additional hazards and ergonomic issues. During visits carried out as part of baseline assessment, the floor areas were often found to be wet and slippery due to constant operation and lack of routine cleaning. Due to lack of proper ventilation systems, it was observed that fugitive emissions from various stages of processing adversely impacted the Indoor Air Quality.

While Surat is one of the clusters with the highest worker wages, the basis of wage determination varies in different types of units. For example, while a weaving unit worker earns based on the number of metres of cloth processed per day, a processing unit worker earns a fixed daily income.

Most textile units recruit the workers through contractors. These contractors, often themselves migrants, act as a focal point between the textile units and the pre-dominantly migrant workforce from their region. Based on discussions with stakeholders, it is estimated that 90 percent of the total workforce in the Surat textile cluster are migrant labourers, coming from Odisha, Uttar Pradesh, Bihar, West Bengal and Andhra Pradesh. Due to such a high concentration of migrant workforce, the industry faces a serious labour shortage from April to June and during festive seasons, when workers return to their hometowns.

Once the workers arrive in Surat, finding a job is not difficult due to high demand and constant market competition. However, facilities for migrant labourers are less than desirable. A few upcoming textile parks have developed workers'

hostels and canteens, however currently, majority of the workers stay in crowded rooms with dismal living conditions. There is a need for improving the living conditions of workers, as well as providing economic options for transport.

Surat textile sector employs around 11,65,000 people in both MSME and large-scale industries (WRI India, 2021b). Most weaving and processing units have 80-100 percent male workforce. Women find employment in Jari, Embroidery and Stonework sections, where their numbers are equal to or more than their male counterparts. Such gender inequality is often justified by the units by associating it with the safety of female workers, as shifts in the processing and weaving units are uncertain and physically demanding. However, clusters like Tiruppur and Bhiwandi have set examples of how women can be safely included in the workforce in such units, while working in night shifts and performing heavy duty work.

Other examples for improving social sustainability can be seen in Pandesara and Sachin Industrial Clusters where schools have been established for children of workers.

A summary of gaps and recommendations with regards to achieving social sustainability in all processes and systems is provided in Table 7:

Gaps Identified	Recommendations
Poor housekeeping	Develop and implement appropriate housekeeping methodology
	Improve ventilation systems to address indoor air quality issues
Lack of facilities like hostels/ canteens for workers	Develop partnerships with stakeholders and government to establish common facilities for respective clusters/zones/parks
Workplace Safety and Emergency Preparedness	Develop a health and safety plan
	Develop emergency/disaster management plans and carry out mock drills regularly
	Ensure compliance of Occupational Health and Safety standards by units
	Adopt Recognized And Generally Accepted Good Engineering Practices (RAGAGEP) to increase safety of operations
	Develop and implement cluster-wide common firefighting infrastructure like fire hydrant systems and fire stations
Negligence by workers in adopting safety measures	Organise regular safety training for workers to bring in behavioural changes
Low levels of participation of women in the workforce	Train and employ women in different stages of the textile value chain and provide safe working conditions
	Ensure 50 percent of women workforce in General Shifts
Inadequate transportation for personnel	Provide economic modes of transport for personnel movements between markets, industries and residential areas
Unskilled workforce	Support skilling and capacity building of workers

Table 7: Social Sustainability: Gaps & Recommendations

2.6

Transport and Freight

There are 58600 textile shops in and around 185 textile markets in Surat (FOSTTA, 2021). Textile traders play a central role as the demand first reaches the market, where the trader procures the grey fabric from the weaver(s) and supplies it for processing to the textile units. The processed fabric is again re-routed for value addition through the trader. The finished product on re-entering the market is then delivered to different parts of the country. The trader acts as a checkpoint for ensuring quality at each stage and the multiple re-routing steps open up channels for sale and redistribution of semi-finished goods.

A typical flow of textile goods from grey fabric to finished product for Surat is shown in Figure 14.

Textile Goods Transport Association, 2022). In peak season, each vehicle completes atleast 2-3 trips between the units and the market. Being the epicentre of this activity, the textile market often experiences high congestion. The freight vehicles are diesel-driven and their high density in market areas leads to localised air pollution. Additionally, a fleet of around 300 Heavy Commercial Vehicles (HCVs) is used to freight goods in and out of Surat City.

In Surat, 38-40 percent of the total urban freight trips generated in the city is contributed by the textile industry alone (Dhonde and Patel, 2020). Furthermore, the increasing spread of the sub-clusters has resulted in increased number and length of the trips.

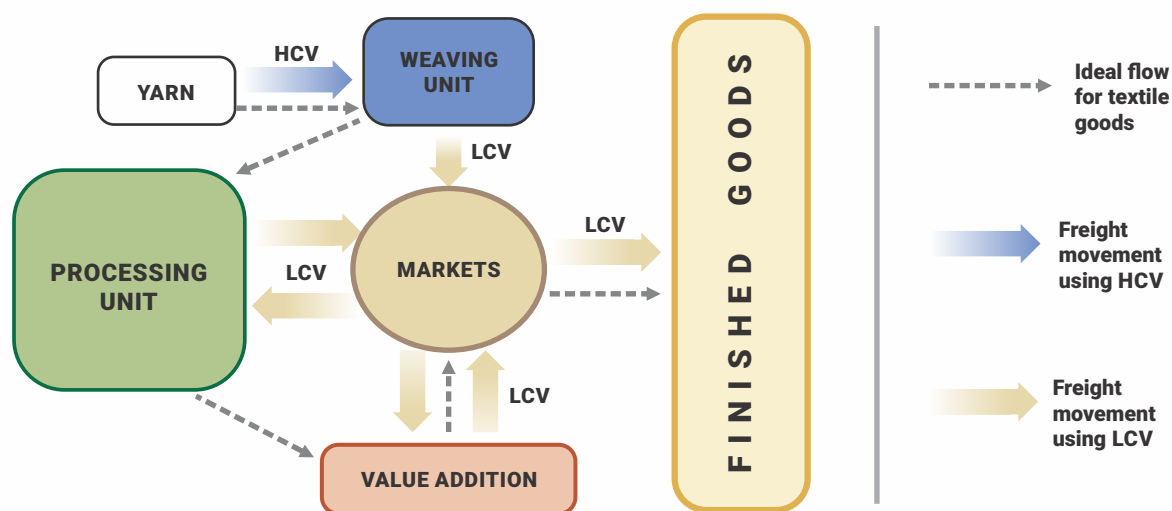


Figure 14: Movement of Goods

Source: Dhonde and Patel, 2020

In the Surat city, atleast 2500 Light Commercial Vehicles (LCVs) are used to transfer goods between the industrial clusters and the market (Source: Surat

Currently, the State Electric Vehicle Policy 2021 by SMC does not promote procurement of e-Freight. This issue needs to be addressed as use of e-Freight

could reduce localised air pollution. There is also a need to plan industrial and non-industrial land use along with freight transport planning, as proper planning

can also have a significant impact on reducing congestion. 500 public charging stations have been planned by 2025 (SMC, 2022).

A summary of gaps and recommendations with regards to optimising transport of goods and promoting e-Freight is provided in Table 8:

Gaps Identified	Recommendations
High emissions from fossil fuel based LCVs and HCVs	Promote and support gradual replacement of old diesel fleet with new pollution free e-vehicles
	Implement vehicle scrap policy for LCV
	Develop Low Emission Zone (LEZ) in high congestion areas
	Optimise movements of goods between textile markets and the units
Adoption of e-freight	Facilitate inclusion of LCV in EV policy to promote transporters to invest in e-freight
	Support development of EV charging infrastructure
	Convert at least 30 percent of diesel LCVs to EV by 2030

Table 8: Transport & Freight: Gaps & Recommendations





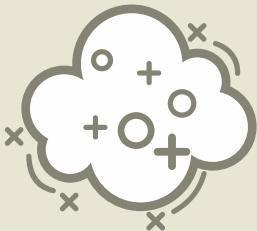
ROADMAP 2030

3

Roadmap 2030: Transforming Surat Textile Cluster into a Sustainable Textile Hub

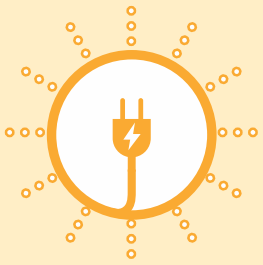
Based on gaps and recommendations discussed in the previous section, further prioritization was carried out in consultation with the stakeholders to develop goals and priority actions to address the most pressing concerns. The goals for the six impact areas and the key determinants for setting of these goals are discussed

Table 9: Roadmap 2030 Goals and Actions

Impact Areas	Goals	Recommendations	
Air Quality 	1.To reduce particulate emissions and achieve PM10 concentration of 60µg/m³ as per the national ambient air quality standard in Industrial areas by 2030	1.1 Strengthen the Air Quality Monitoring Network by setting up manual, sensor-based and Continuous Ambient Air Quality Monitoring Stations (CAAQMS)	
		1.2 Expand the pilot Emission Trading Scheme (ETS) to all eligible units	
		1.3 Upskilling of operators and maintenance personnel for efficient maintenance of Air Pollution Control Devices (APCDs)	
		1.4 Ensure use of authorized fuel in all units	
		1.5 Increase peripheral green cover around industrial estates	
		1.6 Install combustion control systems in boilers	
		1.7 Commission community boilers for new industrial parks	
		1.8 Identify techniques to optimize the mixture of Refuse Derived Fuels, Biomass Briquettes and Coal	
Water & Chemicals 	2.To increase the share of recycled water for industrial uses to 50 percent by 2025 and 100 percent by 2030	2.1 Perform water audits to identify sources of water loss, minimize wastage and promote internal recycling	

in Annexure 1. The Roadmap lists priority actions, which are presented along with the most critical next steps required to kick start the actions, as agreed by the stakeholders. The actions are also categorised as Short Term (2023), Medium Term (2025) and Long Term (2030), based on the proposed implementation period.

CRITICAL NEXT STEPS	TIME LINE	KEY STAKEHOLDERS
Identify locations for installation of monitoring stations	Medium Term	GPCB, CPCB, SMC, Industry Associations
Establish regulatory framework based on the results and analysis of the pilot study	Medium Term	GPCB, Units
Awareness campaigns and capacity-building sessions	Medium Term	Units, Industry Associations, MANTRA
Policy intervention supported by adequate monitoring and enforcement	Medium Term	GPCB, Industry Associations, Directorate of Boilers - GoG
Awareness campaigns and afforestation activities	Medium Term	Units, Industry Associations
Create awareness along with identification of schemes for financial assistance	Medium Term	Units, Directorate of Boilers - GoG
Identify various initiatives by Central and State government for financial assistance	Long Term	Industry Associations, Directorate of Boilers - GoG, GIDC
Promote research and collaborative actions	Long Term	Industry Associations, Directorate of Boilers - GoG, GPCB
Awareness campaigns and capacity-building sessions	Short Term	Units

IMPACT AREAS	GOALS	RECOMMENDATIONS	
Water & Chemicals 		2.2 Gradually replace reactive dyes with eco-friendly/ natural dyes to increase efficiency of water treatment at Common Effluent Treatment Plants (CETPs)	
		2.3 Adopt Zero Discharge of Hazardous Chemical (ZDHC) Initiative	
		2.4 Promote the use of recycled water over fresh water by providing incentives	
		2.5 Support development of CETPs and other associated critical infrastructure for maximum recycling of treated effluent	
		2.6 Support infrastructure development for supply of treated sewage water to reduce freshwater demand	
Energy Efficiency and Clean Energy 	3.To reduce dependency on fossil fuels and achieve atleast 50 percent energy from non-fossil fuel-based energy resources by 2030	3.1 Skill boiler operators to increase operational efficiency	
		3.2 Perform energy audits to identify sources of energy loss and increase energy efficiency	
		3.3 Promote development of group captive solar parks	
		3.4 Accelerate adoption of energy efficient technologies.	
		3.5 Boost domestic machinery manufacturing for the textile sector	
Solid Waste 	4.To develop mechanisms for collection, handling, sorting, and reutilisation of 100 percent pre-consumer textile waste by 2030	4.1 Develop classification of pre-consumer textile waste	
		4.2 Develop guidelines for collection, handling and sorting of textile waste	

Critical Next Steps	Time Line	Key Stakeholders
Promote research on alternate to reactive dyes	Medium Term	CETPs, Units, MANTRA
Policy intervention based on research and inter-departmental collaboration	Medium Term	Units
Identification of appropriate incentivisation mechanism and policy support	Medium Term	SMC, CETPs, Industry Associations, Units
Identification of various initiatives by Central and State government for financial assistance	Long Term	SMC, Industry Associations, CETPs Units
Mapping of STPs and clusters for development of treated water supply networks	Long Term	SMC, Industry Associations, CETPs, Units
Awareness campaigns and capacity-building sessions	Short Term	Units, Industry Associations, MANTRA
Awareness campaigns and capacity-building sessions	Short Term	Units
Identify various initiatives by Central and State government, and private institutions for financial assistance	Medium Term	Units, Industry Associations
Cataloguing of Best Available Techniques (BATs) and policy intervention to promote their adoption	Long Term	Units, Industry Associations, GCPC
Policy intervention and financial support	Long Term	GoG, GoI
Undertake studies to gather data and insights	Short Term	Industry Associations, GPCB, SMC
Perform research followed by regulatory action	Short Term	GPCB, SMC

IMPACT AREAS	GOALS	RECOMMENDATIONS	
		4.3 Identify and authorize waste collectors to ensure proper handling, reuse, recycling or disposal of textile waste	
		4.4 Promote recycling of textile waste	
Social Sustainability 	5.To achieve social sustainability in all systems and processes	5.1 Develop and implement appropriate housekeeping methodology	
		5.2 Support skilling and capacity building of workers	
		5.3 Organize routine safety training for workers	
		5.4 Ensure compliance with Occupational Health and Safety standards by units	
		5.5 Improve ventilation systems to address indoor air quality issues	
		5.6 Train and employ women in different stages of the textile value chain and provide safe working conditions	
		5.7 Adopt Recognized And Generally Accepted Good Engineering Practices (RAGAGEP) to increase safety of operations	
		5.8 Develop and implement cluster-wide common firefighting infrastructure like fire hydrant systems and fire stations	
Transport and Freight 	6.To promote use of Electric Vehicles (EV) for freight and personnel movement	6.1 Develop Low Emission Zones (LEZs) for movement of Freight vehicles in high congestion zones	
		6.2 Optimise movements of goods between textile markets and the units	

Critical Next Steps	Time Line	Key Stakeholders
Build capacity of waste collectors to ensure proper handling of waste and initiate supportive policy interventions	Medium Term	GPCB, SMC, Industry Associations
Identify solution providers for recycling of textile waste	Medium Term	SMC, MANTRA, Industry Associations
Support from industry associations to popularize action	Short Term	Units, Industry Associations
Policy intervention and financial support	Short Term	Industry Associations, GoG, Units, MANTRA
Awareness campaigns and capacity-building sessions	Short Term	Units
Awareness campaigns and capacity-building sessions	Medium Term	Units, Industry Associations, Commissionerate of Labour- GoG
Create awareness and support implementation of actions by individual units	Medium Term	Units
Institutional action to identify barriers to participation of women in the workforce	Medium Term	Industry Associations, Units, Commissionerate of Labour- GoG, MANTRA
Awareness campaigns and capacity-building sessions	Medium Term	Industry Associations, Units
Policy intervention for infrastructure development	Long Term	Industry Associations, GIDC
Undertake studies to identify the most effective mechanisms for development of LEZs	Medium Term	SMC, RTO, Traffic Department
Undertake studies to map freight routes and patterns of freight transport	Medium Term	SMC, Industry Associations, Units

IMPACT AREAS	GOALS	RECOMMENDATIONS	
		6.3 Develop economic and sustainable modes of transport (for example e-buses) for personnel movements between markets, industrial estates and residential areas	
		6.4 Develop Electric Vehicle (EV) charging infrastructure between market and industrial areas to promote the use of electric vehicles for freight movements	
		6.5 Convert at least 30 percent of diesel LCVs to EV by 2030	

LEGEND:

CPCB – Central Pollution Control Board

GCPC – Gujarat Cleaner Production Centre

GEDA – Gujarat Energy Development Agency

GIDC – Gujarat Industrial Development Corporation

GoG – Government of Gujarat

GoI – Government of India

GPCB – Gujarat Pollution Control Board

MANTRA – Man Made Textiles Research Association

RTO – Regional Transport Office

SMC – Surat Municipal Corporation

STP – Sewage Treatment Plant

CRITICAL NEXT STEPS	TIME LINE	KEY STAKEHOLDERS
Undertake extensive needs analysis for personnel movement	Medium Term	Units, Industry Associations, SMC
Create awareness and gain support from market stakeholders to popularize the action	Long Term	GEDA, Industry Associations, SMC
Infrastructure development coupled with policy intervention	Long Term	Industry Associations, SMC, GoG

3.1

Way Forward

The Roadmap development exercise undertaken in the Surat textile cluster has emerged as a successful model for cluster-based interventions that can promote the adoption of sustainable practices at a

scale. It also showcases the importance of collaborative and participatory approaches for bringing together key stakeholders in a textile cluster and building consensus on actions that can support the transformation of the cluster into a sustainable textile hub. Such consensus is especially crucial in light of the fact that achieving the goals laid out in the Roadmap will depend primarily on self-regulatory models, where stakeholders voluntarily participate in adopting the recommended actions.

The implementation of the Roadmap will require concerted efforts and unprecedented levels of collaboration between all key stakeholders. These efforts would also need to be orchestrated and supported through the institutionalization of an appropriate mechanism for ownership of the Roadmap and its implementation. Access to finance, institution of supportive policies, and fostering research and innovation will be critical for the successful implementation of the Roadmap. Supporting the adoption of actions by bringing about behavioural changes amongst textile unit employees, raising awareness on existing policies, and ensuring access to relevant information will also be vital.

Additionally, some proposed interventions in the Roadmap require a deeper analysis of the status quo and needs of the cluster, which could be facilitated by initiating deep-dive studies, as well as improving data availability and encouraging data transparency from textile units. The development of a robust monitoring and evaluation framework will also be vital to assess progress at regular intervals and glean feedback for periodically updating the Roadmap goals and actions. The Roadmap actions would also have to be updated in line with advancements in sustainability practices and technologies, increased understanding of their impact and the enabling ecosystem for their adoption - for example, the evolution of alternatives in sustainable transportation that could replace / complement EV adoption.

Even as the actions in this Roadmap are taken up for implementation by relevant actors, there is a critical need to sensitize stakeholders to more ambitious and systems-level actions, which can, for instance, prevent the generation of waste and pollution in the first place, rather than addressing waste and pollution after they have been created. Dedicated efforts will be required to garner support for the uptake of these actions in the cluster. Such actions could include:

- Minimising production of by-products through patterning and fabric management processes to minimise the volumes of offcuts; and where unavoidable ensuring that they are used as high-value resources
- Eliminating chemicals of concern from the production processes, by working

in collaboration with the relevant stakeholders

- Managing waste streams to ensure they can be used or sold for optimum utility, and exploring approaches to utilising waste materials in new products

While currently perceived as ambitious, such actions are critical for supporting a holistic transformation towards a sustainable and circular textile value chain in India.

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ANNEXURE 1

Setting the Roadmap 2030 goals

1. To reduce particulate emissions and achieve PM10 concentration of 60µg/m³ as per the national ambient air quality standard in Industrial areas by 2030

The current annual average PM10 concentrations in Industrial areas is 128.61µg/m³ (Calculated from data obtained from GPCB, Figure 4). The national ambient air quality standards PM10 concentration is 60µg/m³. To achieve this concentration there is a need to reduce atleast 53.35 percent of the PM10 load.

2. To increase the share of recycled water for industrial uses to 50 percent by 2025 and 100 percent by 2030

SMC currently recycles 319MLD of sewage water and supplies 160MLD of treated water to Industrial areas (Source: SMC, 2022). This is almost 36 percent of the documented water use of 450MLD. Additionally, SMC plans to supply 194MLD of water to Palsana and Kadodara regions, adding a further 43 percent to the water use. Keeping in mind expansion of cluster, and increase in water demand the target of 100 percent by 2030 was set.

3. To reduce dependency on fossil fuels and achieve atleast 50 percent energy from non-fossil fuel-based energy resources by 2030

Currently, the total annual consumption of Surat Industrial Cluster is 345977MWh (Source: DGVCL and Torrent Power, 2019). Some units have already installed Solar Rooftops of upto 1MW capacity under the government Solar Power Policy. With plans to set up Waste to Energy Plant of 11.5MW capacity (Source: SMC, 2022), use of RDF and promotion of community solar parks, it was discussed with stakeholders from Surat, and the Climate Change Departments (GoG) target, to set an ambitious target of 50 percent.

4. To develop mechanisms for collection, handling, sorting, and reutilisation of 100 percent pre-consumer textile waste by 2030

Disposing textile waste has been a major challenge for industries, markets, SMC and even the Pollution Control Board. The Roadmap 2030 actions under the

target proposes development of collection mechanisms and promotion of textile recycling and upcycling techniques. Similarly, the Roadmap 2030 also proposes, to study the possibility of developing waste valorization techniques like waste to energy plants. Based on these propositions and discussions during stakeholder meetings, a target of 100 percent was fixed.

6. To promote use of Electric Vehicles (EV) for freight and personnel movement

The target integrates the city's target under NCAP to procure e-buses for personnel movement by addressing movement of workers to and from industrial areas. Furthermore, the current policy landscape for EV does not mention or support procurement of e-freight vehicles. In the Surat city, atleast 2500 diesel LCVs are used to transfer goods between the industrial clusters and the market (Source: Surat Textile Goods Transport Association, 2022). Additionally, 300 HCVs is used to freight goods outside of Surat City across India. The target sets to promote procurement of e-freight of atleast 30 percent of total LCVs by 2030. Similarly,

ANNEXURE 2

Water Footprint

Water Footprints can be measured for a single process such as growing cotton, for a product, such as a pair of jeans or for an entire multi-national company. Water footprint provides information about how much water is consumed by a particular product, company, country or globally in a specific river basin or from an aquifer.

The Water Footprint of the 3 textile mills was assessed based on the information available in the environmental audit reports and is comprised of the direct water consumption in the processing units as well as indirect water consumption relating to the electricity, fuel and the raw material (polyester) input. The water footprint is made of three components, green, blue, and grey.

Green Water Footprint: It is the water that reaches the ground due to precipitation (rain/snow), it is stored below the soil, and it is evaporated, transpired or incorporated by plants. It is particularly relevant to agriculture, horticulture and forestry practices. Green water footprint is not relevant for Polyester processing and hence is not considered for this assessment.

Blue Water Footprint: It is the water that is obtained from surface water or groundwater resources and is either evaporated, utilized into a product or taken from one water body and returned to a different waterbody, or returned at a different time. Irrigated agriculture, industry and domestic water use can each have a blue water footprint. Blue water footprint in the units is for direct water use in various operations and the indirect water use in polymer production, energy generation, etc.

Grey Water Footprint: it is the quantity of freshwater that is required for degradation of pollutants to meet specific water quality standards. Point source pollution discharges into the freshwater resource directly by a pipe or indirectly by runoff or leaching from soil, impervious surfaces, or other diffuse sources are all considered under grey water footprint.

Water footprint data for polyester, electricity and fuel (coal, gas, diesel) were retrieved from Mekonnen, Gerbens-Leenes and Hoekstra, (2015) and (Freitas, Zhang and Ruth, (2017).

For the raw polyester calculation, uses the amount of documented gray cloth. The Water Footprint value for polyester filament yarns was chosen due to character of

the produced fabric in the mills. The lowest value in the range was chosen to be conservative. For the fuel consumption calculations, the methodology of the Mekonnen, Gerbens-Leenes and Hoekstra, (2015) was used. The lowest value in the Higher Heating Value (HHV) of the fuels was taken to be conservative.

Some of the mills use recycled water, but since this is already included in the direct water use reported by the mills, no further processing of the data is needed.

Results table for 3 sample industries are attached below:

Unit A water consumption per year:

Unit A				
Direct WF				
	Consumption value	Blue WF (m ³ /year)	Grey WF (m ³ /year)	Total direct WF (m ³ /year)
Freshwater	158657,39	158657,39	NA	158657,39
Indirect WF				
	Consumption value	Blue WF (m ³ /year)	Grey WF (m ³ /year)	Total indirect WF (m ³ /year)
Raw polyester	3395,18	169758,88	171931788,60	172101547,48
Coal consumption (tonnes)	5416,54	19081,53	NA	19081,53
Electric consumption (kWh)	2341285,00	2082,71	NA	2082,71
Total WF per year April 2020 - March 2021 (m³)	172281369,11			
WF per metre cloth (m³)	6,60			

Unit B water consumption per year:

Unit B				
Direct WF				
	Consumption value	Blue WF (m ³ /year)	Grey WF (m ³ /year)	Total direct WF (m ³ /year)
Freshwater	293054,00	293054,00	NA	293054,00
Indirect WF				
	Consumption value	Blue WF (m ³ /year)	Grey WF (m ³ /year)	Total indirect WF (m ³ /year)
Raw polyester	2310,91	115545,35	117024325,92	117139871,27
Fuel consumption				
Coal (tonnes)	7620,74	26846,55	NA	26846,55
Diesel (liters)	10525,00	399,95	NA	399,95
Electric consumption (kWh)	2613612,00	2324,96	NA	2324,96
Total WF per year April 2020 - March 2021 (m³)	117462496,73			
WF per metre cloth (m³)	7,33			

Unit C water consumption per year:

Unit C				
Direct WF				
	Consumption value (m ³ /year)	Blue WF (m ³ /year)	Grey WF (m ³ /year)	Total direct WF (m ³ /year)
Freshwater	397.441,00	397.441,00	NA	397.441,00
Indirect WF				
	Consumption value	Blue WF (m ³ /year)	Grey WF (m ³ /year)	Total WF (m ³ /year)
Raw product	5.068,00	253.399,77	256.643.287,06	256.896.686,83
Fuel consumption				
Natural gas (SCM)	9.746,15	41,99	NA	41,99
Coal (tonnes)	53.377,38	188.039,27	NA	188.039,27
Electric consumption (kWh)	5.099.170,00	4.536,02	NA	4.536,02
Total WF per year April 2019 - March 2020 (m³)	257.486.745,11			
WF per metre cloth (m³)	6,60			



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