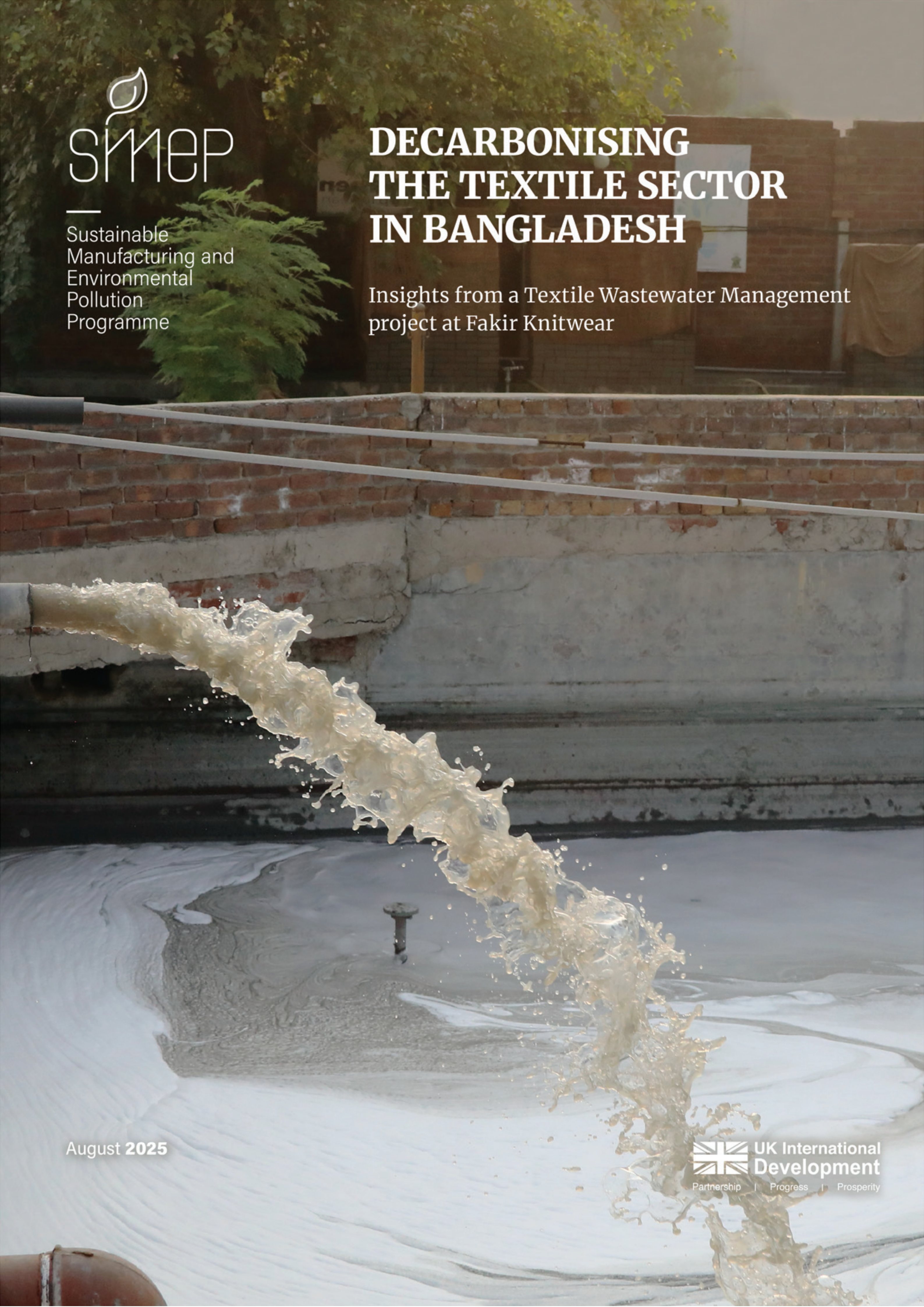

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Sustainable Manufacturing and Environmental Pollution Programme

DECARBONISING THE TEXTILE SECTOR IN BANGLADESH

Insights from a Textile Wastewater Management project at Fakir Knitwear

August **2025**

UK International Development

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1.

Summary

Led by Primark and Panta Rei Water Solutions, with support from Fakir Knitwear Ltd., Grundfos, WaterAid and H&M, this SMEP Programme collaboration demonstrates how integrating advanced tertiary wastewater treatment and reuse technologies, such as ultrafiltration and reverse osmosis, can significantly reduce greenhouse gas (GHG) emissions, by reducing water and chemical usage in the textile sector. **By reusing 50 per cent of wastewater and reducing softening agents**, the project will potentially achieve **GHG emission reductions of 30.3 kgCO_2e and 17.8 kgCO_2e per cubic meter (m^3) of treated water, compared to untreated and secondary-treated scenarios, respectively. Scaling similar systems to 25 per cent of wastewater treated across the industry** could help Bangladesh to **conserve over 43 million m^3 of groundwater annually and cut GHG emissions by 1.5 to 2.6 million tonnes CO_2e, contributing 4–7 per cent toward Bangladesh's 2030 Nationally Determined Contributions (NDC) targets**. To enable scale-up across the industry, the study recommends implementing financial incentives and establishing multilateral partnerships for infrastructure deployment, and embedding circular economy frameworks into national policy alongside robust monitoring and verification systems. The study also emphasises having supportive trade mechanisms (considering both tariff and non-tariff measures) to facilitate technology transfer from developed to developing countries.

↓ Image 1. Wastewater treatment facility at Fakir Knitwear, Dhaka, where SMEP Programme, Primark, Panta Rei, Fakir Group, and H&M collaborate to reuse wastewater, cutting chemicals, conserving groundwater, and reducing GHG emissions.

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2.

Technical aspects of wastewater treatment in the textile industry

With the globalisation of textile value chains and technological advancement, fast fashion provides consumers across the world access to a constant source of new styles at affordable prices (European Parliament, 2020). Unfortunately, how we make clothes now is primarily linear, based on a "take-make-dispose" system. Globally, just 0.3 per cent of the materials used to produce textiles come from recycling, and almost none of this involves recycling old clothes back into new ones (Circle Economy, 2024).

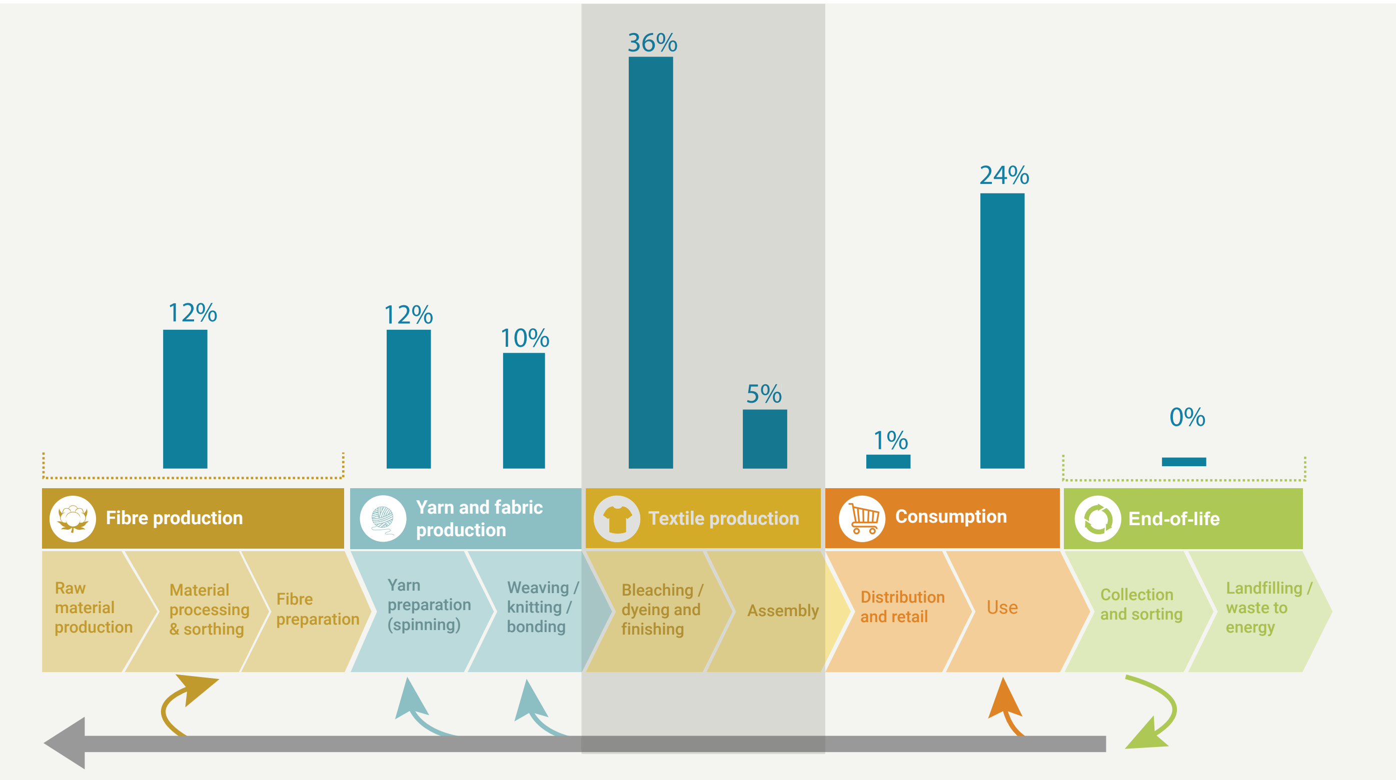
The textile sector is highly material-intensive, consuming around 109 million tonnes of fibres in 2020. The majority of these are synthetic fibres such as polyester (64 per cent), followed by cotton (24 per cent) (Quantis, 2018). In addition to raw materials, the industry requires substantial amounts of land, water, and chemicals, and contributes significantly to environmental pollution. It is estimated to account for around 20 per cent of global clean water pollution from dyeing and finishing processes, 3.5 per cent of global water scarcity, and 5 per cent of nutrient overload that disrupts marine and freshwater ecosystems. The sector is also responsible for nearly 3.5 per cent of global GHG emissions (Circle Economy, 2024; European Parliament, 2020).

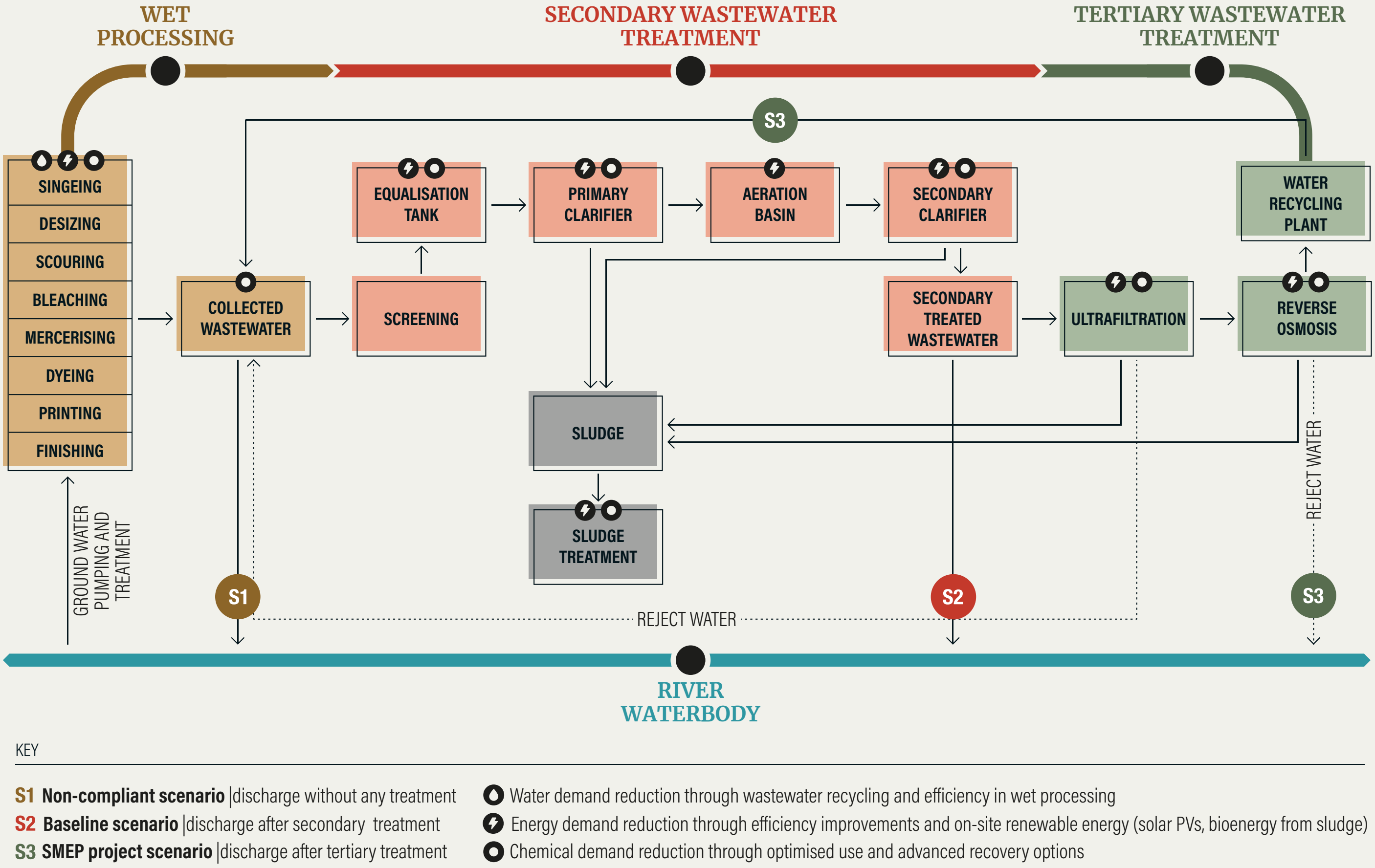
According to the European Environmental Agency 2023 report (EEA, 2023), the clothing of an average person in Europe in 2020 would represent about 400 square meters (m^2) of land, 9 cubic meters (m^3) of fresh water and around 391 kg of raw materials. The carbon footprint of fast fashion consumption is *11 times higher* (2.50 $kgCO_2e$ for one wear jeans) than that of traditional fashion (Li, et al., 2024).

Comparing different phases of the value chain (including, production, logistics, consumption, and discarding processes), the manufacturing stage in textiles production has the highest climate impact (41 per cent), followed by the use phase (24 per cent) as shown in Figure 1.

↓ Figure 1. **Climate impact across the global apparel value chain**

Source: UNEP (2022).





↑ Figure 2. **Potential opportunities for the reduction of material use and GHG emissions**

Source: Adapted from Panda, et al., 2021 and Azanaw, et al., 2022

Instead of a linear fast fashion, circular design and manufacturing of textile and apparel focus on more durable, repairable, reusable, and recyclable clothing, which would reduce the material inputs, create less pollution and result in less GHG emissions. A detailed emission reduction opportunities mainly at the manufacturing phase is presented in Figure 2.

This technical brief examines the potential GHG emissions reductions through water circularity and improving the water quality of industrial wastewater treatment in Bangladesh, one of the Sustainable Manufacturing and Environmental Pollution (SMEP) Programme projects funded by the UK International Development and implemented by the UK Foreign, Commonwealth and Development Office (UK-FCDO) in partnership with the UN Trade and Development (UNCTAD). The scope of the GHG emissions reduction is part of the SMEP Programme's reporting requirement of the International Climate Finance (ICF) KPI 6. The key assumptions of the GHG emissions are listed in Annex A1.

2.1. Sectoral greenhouse gas emissions reduction opportunities

The GHG emissions in the textile manufacturing process mainly relate to energy use for processing textiles, and the resources (e.g., water) and chemicals used. Depending on the manufacturing countries, water used in the process is sourced from the local utilities, surface water (e.g., rivers), or groundwater.

The wastewater generated after wet processing in the textile industry is characterised by different pollutants depending on the processing stage (Panda, et al., 2021). Sizing/desizing generates high biological oxygen demand (BOD),[1] chemical oxygen demand (COD),[2] and surfactants. Scouring wastewater is alkaline, containing fats and oils. Bleaching contributes oxidizing agents and salts. Dyeing produces wastewater with colour, salts, heavy metals, and dye residues. Printing produces wastewater including thickeners, binders, and pigments, while finishing adds silicones and softeners to the effluent. Thus, various chemicals are used for treating the wastewater in a typical activated sludge wastewater treatment (WWT) plant.

1 Biochemical Oxygen Demand (BOD) is a measure of the amount of dissolved oxygen consumed by microorganisms while decomposing organic matter in a water sample under aerobic conditions.

2 Chemical Oxygen Demand (COD) is a measure of the amount of oxygen required to chemically oxidize the organic compounds present in a water sample.

↑ Image 2. Untreated (left) and treated (right) wastewater samples from a textile manufacturing process, demonstrating the impact of advanced treatment on water quality and potential GHG emissions reduction.

The GHG emissions reduction consider both direct and indirect emissions related to advanced WWT. The direct emissions of the case considered (Fakir Knitwear) include the emissions from the on-site biological treatment processes (mainly using the electricity to operate equipment) and sludge management, including landfills and on-site combustion of fossil fuels, such as diesel/gas-powered electricity generation to run the factory and WWT (Scope 1). The indirect emissions (Scope 2) are likely to be from the purchased electricity, heat, or steam consumed by treatment plants (US-EPA, 2025). Other indirect emissions include producing and transporting chemicals used in the treatment process and off-site sludge disposal (Scope 3 emissions). As part of WWT, aeration[3] is one of the most critical and energy-intensive processes, consuming up to 50–60 per cent of the overall energy required by a WWT plant (Mendoza, 2023).

Circular economy opportunities for materials and GHG emissions reduction at the textile manufacturing stage could mainly be achieved through:

i. Reduction of energy demand by improving energy efficiency and sourcing of on-site renewable energy (e.g. solar PVs, bioenergy from sludge using Anaerobic Digestion);

ii. Recovery of heat from the weaving and knitting process and from the wastewater through heat exchangers (e.g. Shell-and-Tube or Plate heat exchangers);

iii. Reduction of water demand by recycling and reusing of treated wastewater for on-site application and improving water efficiency in the wet processing; and

iv. Reduction of chemicals demand by optimising uses and recovery through advanced chemical recovery options.

The realization of those strategies requires access to products and services which may not be all available in domestic markets. Therefore, enabling trade policy is essential when related products and components need to be imported.

3 Aeration is important in wastewater treatment to supply oxygen needed for the breakdown of organic matter, thereby reducing Chemical Oxygen Demand (COD) and Biological Oxygen Demand (BOD). If untreated, high COD and BOD levels can deplete oxygen in receiving water bodies, contributing to eutrophication and harming aquatic life.

3.

Fakir Knitwear's greenhouse gas emission reduction in Bangladesh
Case study

3.1. Textile industry in Bangladesh

Through its commitments under the Paris Agreement (2016), Bangladesh has committed to 5 per cent reduction (12 million tons CO_2e) in GHG emissions below the 'business-as-usual' level by 2030 as reflected in the country's Nationally Determined Contributions (NDCs). To achieve the emissions reduction targets, Bangladesh aims to achieve 40 per cent renewable energy by 2041, while reducing primary energy consumption per unit of GDP by 15 per cent by 2021 and 21 per cent by 2030 (MEFCC, 2021).

As the second-largest apparel exporter globally (after China) Bangladesh's textile industry accounts for 84 per cent of the nation's exports and contributes approximately 12 per cent to the country's GDP, while employing over 4 million people.[4] At the same time, the textile and apparel sectors are responsible for about 8.2 per cent of national electricity consumption (Khatun and Bari, 2024) and withdrawal of an estimated 1,500 billion litres of water annually (IFC, 2018). Additionally, these sectors contribute approximately 12.4 per cent and 15.4 per cent of the country's GHG emissions, respectively (Light Castle, 2024).[5]

Bangladesh has also committed to achieving the Sustainable Development Goals (SDGs), particularly: ensuring access to safe water and sanitation for all (SDG 6); promoting clean and renewable energy through a just transition (SDG 7); advancing sustainable consumption and production via resource efficiency (SDG 12); and supporting climate mitigation and adaptation (SDG 13). As part of its commitment to a just transition for decarbonising the energy and industrial sectors, and to future-proof Bangladesh's position in the global supply chain, the industry is working to increase the number of LEED-certified factories (targeting 3,500 factories by 2030), promote green exports and sustainability standards, and expand renewable energy installations across manufacturing and industrial zones (ILO, 2023).

4 For more information about key statistics and trends in the textile industry in Bangladesh, visit: https://wifitalents.com/bangladesh-textile-industry-statistics/.

5 For more information about sustainability and emission reduction strategies in Bangladesh's garment industry, visit: https://lightcastlepartners.com/insights/2024/11/green-rmg-bangladesh/.

← Image 3. Workers in the textile industry at Fakir Knitwear, Bangladesh.

3.2. Fakir Knitwear's background and facts

The textile wastewater management project at Fakir Knitwear in Bangladesh aims to promote water reuse in garment factories and provide a proof of concept for scaling up improved wastewater recycling in brands' supply chains. Panta Rei is deploying advanced tertiary wastewater treatment and water recovery systems through ultrafiltration and reverse osmosis (RO). Simultaneously, Grundfos is enhancing the efficiency of four water pumps at the site. In parallel, the consortium is supporting the Primark-funded Energy Resources Integration (ERI) resource efficiency program, which aims to reduce water usage, improve energy efficiency, and lower the chemical content in wastewater. These combined efforts seek to limit pollution and offset the additional energy demands associated with the project's water treatment processes.

Table 1. Key details of the Fakir Knitwear factory in Bangladesh

Factory	Fakir Knitwear
Location	Bangladesh
Leading retail brands	Primark; H&M
Treatment technology	Ultrafiltration; reverse osmosis (RO)
Treatment provider	Grundfos; Panta Rei in collaboration with WaterAid
Annual water use	432,000 m^3

3.3. The baseline scenario for advanced tertiary wastewater treatment and discharge

The Fakir Knitwear plant is located in Dhaka, and this analysis considers that its wastewater is eventually discharged in the Meghna River, which flows past Dhaka city into the Bay of Bengal.

The industrial wastewater treatment in Bangladesh is regulated under various regulatory policies (including Bangladesh Environment Conservation Act, Rules, National Water and Environmental policies, Sector-specific Standards and Guidelines), developed and implemented by the Department of Environment (DoE), Ministry of Environment, Forest and Climate Change, the Government of Bangladesh. GHG emissions reductions from the wastewater treatment have been considered under three scenarios, considering the local regulatory requirements (as shown in Figure 2 and Annex A3):

i. Scenario 1 (S1): Discharge without any treatment (Non-compliant Scenario),

ii. Scenario 2 (S2): Discharge after secondary treatment (Baseline Scenario), and

iii. Scenario 3 (S3): Discharge after advanced tertiary treatment (SMEP project Scenario).

In the non-compliant scenario (S1), wastewater is discharged without any treatment. This reflects, for example, factories that do not comply with local regulations, leading to severe environmental pollution.

Under the baseline scenario (S2 - compliant under the local regulations, listed in Annex A1), wastewater is discharged after secondary treatment, which is often the standard required by local regulatory bodies. The secondary treatment considerably reduces organic matter and suspended solids, though some pollutants may remain (acceptable limits shown in Annex A2a and A2b).

In the specific context of the SMEP project scenario (S3), advanced treatment methods are used to further treat wastewater which has already undergone secondary treatment at the ETP. This produces high-quality water suitable for reuse, thereby minimizing environmental impact and promoting water conservation beyond current standards (under ZDHC regulations – NEP 2018).

↑ Image 4. Haze over Dhaka's skyline, seen from the Buriganga River in March 2024, highlighting industrial pollution that SMEP Programme projects aim to mitigate.

3.4. Potential greenhouse gas emissions reduction

SMEP project at Fakir Knitwear

Fakir Knitwear is one of the well-established textile factories in Bangladesh, with an annual water consumption of 432,000 m³. This is not expected to change in the next seven years (duration of the SMEP project). As a result, considering six years of Reverse Osmosis (RO) operation, the project will treat around 2,592,000 m^3 of wastewater. Thus, the core water-related emissions at Fakir Knitwear have been considered as emissions from (a) wastewater discharge, (b) groundwater pumping and (c) groundwater softening. The reduction of emissions during the SMEP project is shown in Table 2.

This recirculation of treated wastewater back into production halves demand for the electricity from groundwater pumping for factory use. The carbon intensity of Bangladesh's grid-level electricity is 0.61 $kgCO_2/kWh$; therefore, any reduction in electricity demand from decreased groundwater pumping results in emissions savings at a rate of 0.61 $kgCO_2$ for each kilowatt-hour of electricity saved. In addition, Panta Rei's treated wastewater offsets the need for softening agents (with an emission factor of ~0.58 tCO_2e per year) for the groundwater treatment (naturally very hard, requiring lime or other softening agents) before the wet processing.

Thus, the SMEP project at Fakir Knitwear would save a total of 1,296,000 m^3 of water withdrawal from the ground considering the time frame 2024-2031, along with the savings from not requiring the softening agents for the groundwater treatment, resulting in a total GHG reduction of 46,202 tCO_2e (baseline S2) and 78,521 tCO_2e (non-compliant S1). This accounts for around 18 $kgCO_2e/m^3$ of water (baseline scenario / S1) to 30 $kgCO_2e/m^3$ of water (non-compliant scenario) of GHG reduction opportunity using advanced WWT described above.

Table 2. Estimated emissions savings at Fakir Knitwear through SMEP-supported wastewater recovery (tCO_2e)

	2024–25	2025–2031	Total	Reduction
Non-compliant scenario (S1)	—	14,104 yearly	84,621	—
Baseline scenario (S2)	—	8,434 yearly	50,601	—
SMEP project scenario (S3)	—	328 yearly	1,967	—
Emission savings vs. (S1)*	—	13,087 yearly	78,521	92.8 %
Emission savings vs. (S2)*	—	7,700 yearly	46,202	91.3 %

→ *Source: Estimated by the authors.*

** Considering a 5 per cent efficiency loss, as per IPCC standards.*

3.5. The sectoral implications of the greenhouse gas reductions in Bangladesh

As a global hub of textile and readymade garments manufacturing, Bangladesh hosts around 1,430 textile mills and 240 dying, printing and finishing mills (BIDA, 2024). To contextualise the sectoral relevance of advanced WWT, textile mills similar to Fakir Knitwear were expected to produce around **349 million m^3 of wastewater in 2021** (Hossain, et al., 2018).

In a scenario where only 25 per cent of the wastewater from these textile mills is treated by an advanced WWT, these GHG emission reductions would be in the order of 1,555,218 tonnes (S2) to 2,643,116 tonnes (S1) each year, **representing 4 per cent to 7 per cent of NDC's emissions reduction targets by 2030**. This would also **save around 43,625,000 m^3 of precious groundwater**, which is critical for water insecure countries like Bangladesh (UNCTAD, 2025).

In addition to water reuse and avoided emissions, the pilot project also offers economic benefits through savings in electricity and softening chemicals, as well as environmental benefits by reducing pollution and bio-/chemical oxygen demand.

Moreover, considering the total expenditure (US$ $1.53 m) of advanced WWT of the Panta Rei technology, it provides around 30.3 kg/US$ (S2) and 51.5 kg/US$ (S1) emissions reduction efficiency per US$ spent in the wastewater treatment technology. Given the economic and environmental benefits (reduction of pollution and GHG emissions) of the SMEP project at Fakir Knitwear, the case study provides a proof of concept, demonstrating regional and global relevance for replication across other mills in Bangladesh as well as in top textile-producing countries, particularly in the Global South.

Further GHG emissions reductions (and co-benefits) can be achieved by adopting better practices in wastewater treatment systems in the textile sector. Biological treatment, such as with anaerobic digesters, artificial wetlands, and activated sludge (aerobic digestion), may lower emissions from wastewater and sludge production by reducing the organic matter and nutrient load. Low operational costs and potential economic use of byproducts (as an energy source or additional income stream) make these methods suitable in the context of developing countries. In cases where heavy and metals or toxic chemicals would be discarded by a textile manufacturer after the filtration and biological treatments, chemical treatment methods like precipitation, coagulation and flocculation can enhance overall performance. Chemical treatments may be selectively used where the cost is justifiable, such as to prevent biodiversity-damaging dyes, non-biodegradable organics, or heavy metals from disrupting filtration and biological treatments. Targeted precipitation or coagulation can also help stabilize concentration of sludge in reverse osmosis systems, ensuring safer disposal while enhancing the overall efficiency and sustainability of the treatment system.

3.6. Co-benefits and trade-offs

Advanced WWT technologies offer numerous environmental, social, and economic co-benefits while reducing GHG emissions. Environmentally, it produces cleaner water bodies by removing pollutants such as heavy metals, microplastics, and excess nutrients. This enables subsequent usage in applications such as regenerative agriculture. Advanced treatment also facilitates water reuse in industrial operations, conserving groundwater resources. Moreover, shifting to renewable energy reduces harmful air emissions, while anaerobic digestion turns waste into valuable resources like biogas and biofertilisers.

Socially, decarbonisation can reduce utility costs for industries and households through energy efficiency and renewable energy use. It also enhances public health by cutting air and water pollution and stimulates green job creation in the engineering and agriculture sectors. These social gains are especially relevant in regions facing employment and health disparities.

Economically, benefits include lower operational costs, improved industrial competitiveness, new revenue streams from carbon credits and resource recovery, as well as maintaining future market access. These drivers can stimulate technological innovation and create markets for sustainable products and services, positioning industries for long-term viability in a low-carbon economy.

However, limitations such as high upfront costs, technical complexity, and shortages of skilled labour, particularly in least developed countries, can be a limiting factor. Regulatory gaps and competition for finite resources may also pose barriers. Addressing these challenges requires coordinated policy, financing mechanisms, capacity-building to ensure inclusive and effective transitions, and affordable access to relevant technologies.

↓ Image 5. Industrial wastewater treatment generates substantial amounts of sludge, which can subsequently be used in applications such as agriculture, provided that chemicals are properly managed.

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4.

Policy implications

4.1. National relevance, partnerships and financial mechanisms

A list of 12 national and sectoral regulatory policies, strategies and action plans in Bangladesh were rated (from high, medium, low and not relevant categories) against the quantified and non-quantified SMEP project's benefits. It shows that SMEP project's outcomes are highly supporting and aligning with all 12 national and sectoral policies and strategies as shown in Annex A4.

The project is highly relevant for regional and global contexts, since the majority of the textiles producing countries (Top 10) are from Asia (China, Bangladesh, Vietnam, India, Pakistan etc.), Europe (Germany, Turkey, Italy, Spain, etc.) and the USA.[6] Countries like Bangladesh, India, Pakistan, and China all face significant water pollution and emissions challenges.

The replication of similar projects widely to transform the textile sector in Bangladesh and other countries (mainly in South Asia), would require financial support and partnerships between various actors in the textile sector, including, labours, manufacturers, regulatory bodies, buyers/retail brands, international organisations including aid, financial institutions, and development banks.

Different financial and governance mechanisms should be considered to uptake similar initiatives in Bangladesh and other countries, including financing vehicles from international and regional development banks, international climate and development financial mechanisms, national, governmental and institutional mechanisms. Also, the sectoral transformation requires affordable access to relevant technologies, technical support and capacity building to ensure appropriate implementation planning and maximizing the decarbonization and water savings goals.

Securing finance is undoubtedly one of the biggest challenges for scaling up such a business. Despite various constraints, there are several initiatives that could be beneficial for the relevant stakeholders in accessing necessary funds and financial support. Table 3 shows potential options for sectoral, national, and international financial and governance mechanisms to scale this initiative in Bangladesh and other countries.

6 For more information about the top textile manufacturing countries in 2024, visit: https://www.royaleuropetextile.com/top-10-textile-manufacturing-countries-in-the-world-fy-2024-update/.

Table 3. Potential sectoral, national and international financial and governance mechanisms

Type of initiatives	Mechanisms/Funds	Scope/Applicability
International Climate and Development Financing Mechanisms	Green Climate Fund (GCF)	GCF is highly relevant to the textile sector, and it has already funded textile and RMG energy efficiency projects in Bangladesh. It could support wastewater treatment, circular economy, and emissions reductions.
	Global Environment Facility (GEF)	Potential for wastewater quality improvement, sludge management, and clean production.
	NAMA Facility	Suitable for replicating ETP and RO-based interventions at industrial clusters.
	Climate Investment Funds (CIF)	Supports scaled-up financing for low-carbon and climate-resilient development. Could support wastewater reuse and renewable-powered ETPs.
	UNDP/UNIDO Programmes	Technical support and funding for the green industry and clean technology.

Table 3. (cont.) Potential sectoral, national and international financial and governance mechanisms

Type of initiatives	Mechanisms/Funds	Scope/Applicability
International Climate and Development Financing Mechanisms	Multilateral /Regional Development Banks	Funding facilities to scale WWT technologies across the textile sector and related industrial zones.
National Financial Mechanisms	Bangladesh Bank Green Transformation Fund (GTF)	Offers low-cost finance for green infrastructure, including water treatment and energy efficiency in export-oriented industries.
	Infrastructure Development Company Limited (IDCOL)	Public-private financing agency supporting renewable energy and green infrastructure projects (co-finance mechanism).
	Export Promotion Bureau (EPB) Green Incentives	Potential incentives for exporters with green credentials (e.g., LEED-certified, water-efficient).
Governance and Institutional Mechanisms	Public-Private Partnerships (PPPs)	Reduces capital burden on individual SMEs; useful in industrial clusters.
	Green Industrial Zones / Eco-Industrial Parks	Promotes circular infrastructure and cost-sharing models.
	Environmental Compliance Bonds / Performance-based Incentives	Can link to ICF/SMEP Programme metrics, e.g., GHG reductions per m^3 treated water.
Voluntary and Private-Sector Mechanisms	Sustainability-Linked Loans (SLLs)	International brands may support suppliers with SLLs for upgrading ETPs.
	Green Bonds or Blue Bonds	Could be issued by local banks, with textile sector as a focus.
	Brand-Supplier Sustainability Programs	A powerful mechanism for scaling green practices via supply chain mandates.
Technical and Capacity Building Mechanisms	Climate Technology Centre and Network (CTCN)	Support technology roadmaps for textile wastewater reuse.
	International Climate Finance KPI Frameworks (e.g., ICF KPI 6)	Ensures future project proposals are results-based and aligned with donor expectations.

↑ *Source: Compiled by authors.*

5.

Key policy recommendations for greenhouse gas mitigation in the textile sector

The proof of concept has confirmed the merit for consideration to scale up similar WWT projects throughout other mills in Bangladesh. It would be worth conducting similar pilots in other manufacturing sites. The following key policy considerations may support the uptake of the textile wastewater management project beyond Fakir Knitwear:

GOVERNMENTS

Integrate the circular economy principles (e.g. wastewater reuse, sludge-to-energy) into national industrial, water, and climate policies to support achieving GHG reduction targets aligning with the Nationally Determined Contributions (NDCs). Performance-based green subsidies, tax incentives, trade facilitation for key components and environmental compliance bonds for factories could help finance the wider adoption of the advanced WWT in the textile industry.

Accelerate green industrial zones, which enable co-finance and co-investment in the infrastructure of advanced WWT and renewable energy pooling in industrial clusters to reduce the cost burdens.

Develop a national digital dashboard for monitoring and certifying pollution and emissions reduction targets linked to performance-based subsidies, while ensuring access to long-term, low-cost capital through national development banks.

PRIVATE COMPANIES AND INDUSTRIES

Including brands & technology providers

Encourage and enable public-private partnerships (PPPs) for co-investment models with the technology providers. Ensure wastewater treatment and GHG reduction are part of supplier sustainability scorecards and procurement criteria.

Support affordable access to technology by collaborating with international and local technology providers to share knowledge and build local capacities that enable affordable solutions.

Enable the ecosystem to share knowledge and technologies, build local capacities, and strengthen centres of excellence to support South–South partnerships and North–South collaboration for affordable access to technology.

INTERNATIONAL ORGANISATIONS AND DONORS

Leverage climate and green funds to support sectoral and regional replication of wastewater reuse and energy efficiency in textiles; support demonstration projects to validate locally adapted circular wastewater treatment technologies; and document and share lessons learned.

Facilitate multi-stakeholder platforms involving governments, industry, financial institutions, and NGOs to support circular economy initiatives and capacity building for institutional and technical readiness, and for affordable access to technology. These platforms should also ensure transparency, replicability, and accountability, while maintaining expected sustainability standards and monitoring mechanisms.

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Annex A1

Technical assumptions and boundaries

The methane emissions from wastewater were quantified by considering the IPCC guidelines.[7] For the groundwater softening, a dose of 54.1 g/kg of textile for Soda Ash (Sodium Carbonate) assumed for groundwater softening.

NOTES AND ASSUMPTIONS

- The emission reduction potentials have been considered from:
    - water reuse and electrical efficiency.
    - avoided dumping and incineration of textiles.
- Incineration of textile waste calculated based on 2006 IPCC guidelines, Vol 5, Chapters 2 and 5.
- Organic loads of wastewater for the projects is unknown, sourced from IPCC guidelines.
- The amount of organic matter removed as sludge is conservatively assumed to be 30 per cent.
- For textiles, COD is assumed to be similar to that for organic chemicals due to the application and working with dyes.
- A working year is assumed to have 260 working days, each of which is 8 hours long. Relevant for hourly/daily wastewater generation volumes.
- Approximately 119 litters of wastewater is generated per kg of fabric.
- Average energy consumption across 15 factories in Bangladesh estimated at 2.58 kWh/kg of fabric.
- The water treatment and recovery plant deployed by Panta Rei in the Fakir Knitwear site is expected to use a maximum of 44,790 kWh per month for its operations
- A 95 per cent additionality parameter was applied as per KPI 6 guidelines.
- Bangladesh Environment Conservation Act (BECA), 1995 and BECA (2010)

7 Based on the 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 5: Waste, Chapter 6 (Wastewater treatment and discharge). Available at: https://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/5_Volume5/V5_6_Ch6_Wastewater.pdf/.

Annex A2

The regulations related to the water quality and wastewater treatment in Bangladesh

Relevant regulations	Key requirements	Sources
Bangladesh Environment Conservation Act (BECA), 1995 and 2010 **Environment Conservation Rules (ECR), 1997**	BECA serves as the foundational environmental legislation in Bangladesh, aiming to conserve the environment, improve environmental standards, and control pollution. BECA mandates that industries, including textiles, must obtain Environmental Clearance Certificates (ECC) and adhere to environmental standards set by the Department of Environment (DoE). The ECR 2010 include the mandatory sludge management and installation of an ETP for industries.	DoE (1995)
National Water Policy (NWP), 1999	The NWP provides a framework for the development and management of water resources, emphasising efficient and equitable water use. It encourages the textile industry to adopt water-saving technologies and practices to minimise water pollution.	GoB (1999)
Bangladesh Standards and Guidelines for Sludge Management, 2015	Depending on the origin, the wastewater sludge is categorised as A (municipal sludge), B (from CETP) and C (from CETP with hazardous nature), which required to follow specific management options and meeting the environmental standards (e.g. substances, heavy metals, etc.), such as, aerobic digestion, composting and agricultural use for category A sludge, controlled landfill, thermal incineration land application (e.g. filling materials) and recycling in brick, cement or asphalt making for category B and only controlled landfill and thermal incineration for category C.	DoE (2015)
National Environmental Policy-NEP, 2018	The NEP aims to integrate environmental considerations into all development activities, promoting sustainable practices across sectors. The policy supports initiatives like cleaner production and zero discharge of hazardous chemicals (ZDHC) in the textile sector.	MEFCC (2018)
The Environmental Conservation Rules (ECR), 2023 SPECIFIC STANDARDS FOR TEXTILE WASTEWATER DISCHARGE	The ECR rules set the maximum limits of wastewater quality before discharge. The maximum limit for colour is set to 150 Hazen (Pt-Co), for COD it is 200 mg/L., and the temperature of the wastewater cannot be more than 5 °C above the temperature of the water body where it will be discharged.	DoE (2023)

Annex A3

Textile wastewater quality standards in Bangladesh

The Environmental Conservation Rules (ECR), 2023

Table A3a. Potential sectoral, national and international financial and governance mechanisms

Parameter	Unit	Maximum limit
pH	—	6-9
Color	Hazen (Pt-Co)	150
Temperature	°C	Maximum 5 °C above the temperature of the water body
Suspended Solids (SS)	mg/L	100
(BOD5 at 20 °C)	mg/L	30
COD	mg/L	200
Total Dissolved Solid (TDS)	mg/L	2100
Oil & Grease	mg/L	10

Table A3b. Maximum limits for some dyes & pigment components (ECR, 2023)

Parameter	Unit	Maximum limit
Chromium (Cr)	mg/L	0.5
Sulfide (S)	mg/L	2.0
Phenol Compounds	mg/L	1.0
Lead (Pb)	mg/L	0.1
Cadmium (Cd)	mg/L	0.02
Cobalt (Co)	mg/L	0.5
Nickel (Ni)	mg/L	1.0

Annex A4

Relevance of SMEP Programme projects to Bangladesh's national and sectoral policies, strategies, and action plans

Relevant regulations	1	2	3	4	5	6	7	8	9	10	11	12
Reduction of GHG emissions	Medium	Medium	Medium	Low	High	High	High	High	High	High	Medium	Medium
Reuse of industrial wastewater	Medium	High	High	Medium	High	High	Medium	Low	Medium	High	Low	Medium
Reduction of groundwater demand	Medium	Medium	High	Low	High	High	Medium	Medium	Medium	High	Medium	Medium
Reduction of chemical demands for groundwater treatment	Low	Medium	Medium	High	Medium	High	Low	High	Medium	Medium	Low	High
Potentials for heat recovery	High	High	Medium	Medium	High	High	Medium	Low	Medium	Medium	Low	High
Potentials for chemicals (e.g. Salt) recovery	Low	Medium	Medium	High	Medium	High	Low	High	Medium	High	Medium	High
Bioenergy from sludge	Medium	Medium	Low	High	Medium	Medium	Low	Medium	High	High	Medium	High

1. Bangladesh Environment Conservation Act (BECA), 1995 and 2010
2. Environment Conservation Rules (ECR), 1997
3. National Water Policy (NWP), 1999
4. Bangladesh Standards and Guidelines for Sludge Management, 2015
5. National Environmental Policy (NEP), 2018
6. The Environmental Conservation Rules (ECR), 2023
7. Nationally Determined Contributions (NDCs), 2022
8. Energy Efficiency Action Plan
9. Bangladesh Climate Change Strategy and Action Plan (BCCSAP)
10. Circular Economy Roadmap/Initiatives
11. National Industrial Policy, 2016
12. DoE Guidelines on Sludge and Chemical Management, 2015

Low Medium High

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