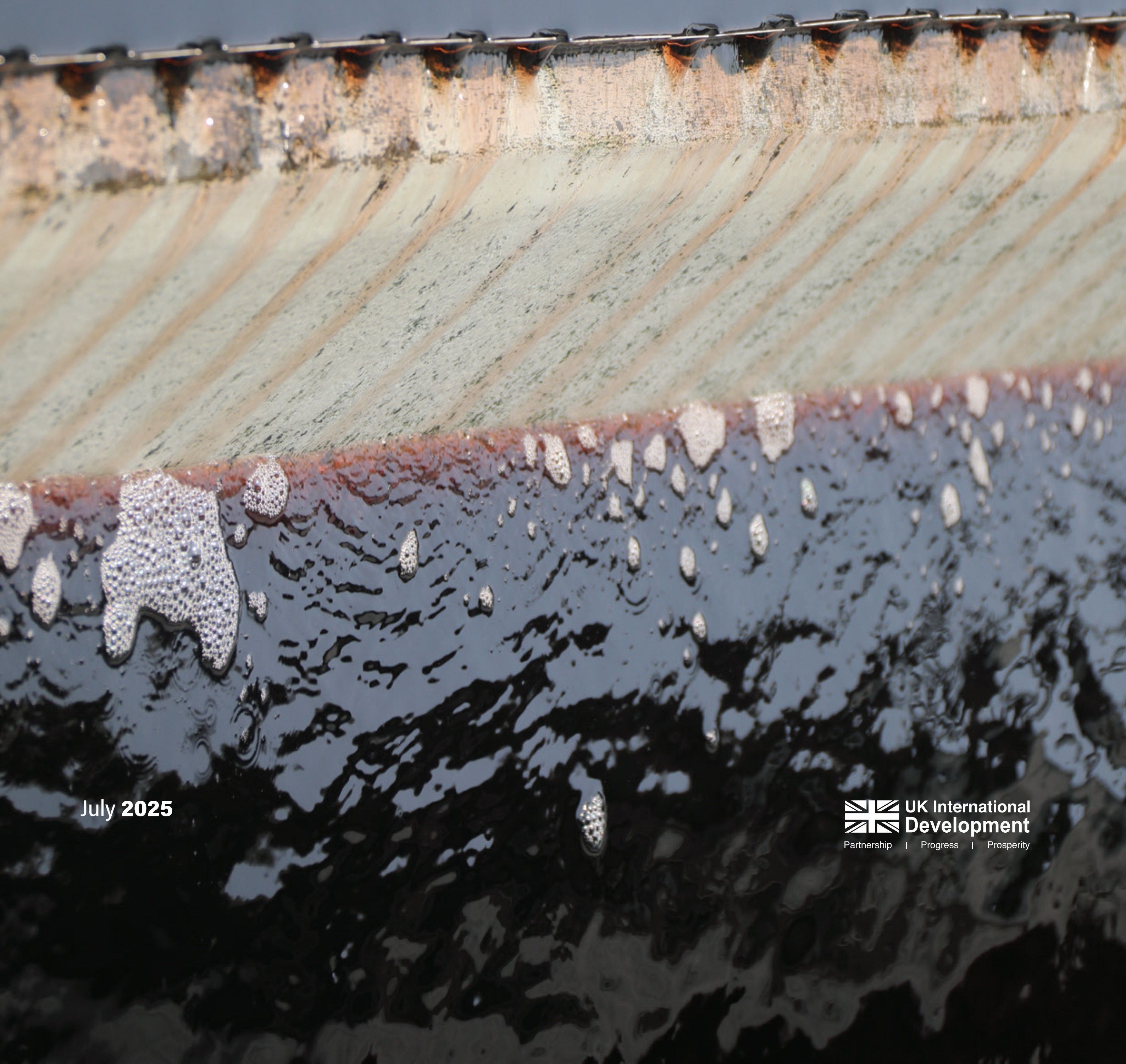
SMEP

Sustainable Manufacturing and Environmental Pollution Programme

BEYOND COMPLIANCE

Trade as a channel for the adoption of industrial wastewater treatment in the Global South



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* SMEP Programme grantees include startups, manufacturing companies, retailers, technology providers, research institutions (e.g., universities), non-governmental organizations and, in some instances, government agencies. Grantees undergo a rigorous procurement process, which includes a technical and due diligence assessment before being awarded a grant under the programme.

Contents

1.

Context

Water emerges as a pivotal element within the context of the triple planetary crisis of climate change, pollution, and biodiversity. As a fundamental resource for all life forms, water plays a multifaceted role in our ecosystems, as a critical input to various sectors in our economies and to human well-being. Human activities, including industrial activity, continue to apply significant pressure on the environment, making water resources more vulnerable to pollution and degradation.

Water scarcity affects large areas and populations across our planet, and many water-insecure countries are economically reliant on water-intensive industries (UNCTAD, 2025a). Data from the World Resources Institute's (WRI) Aqueduct Water Risk Atlas (WRI, n.d.) show that 25 countries — housing one-quarter of the global population — face extremely high water stress each year and regularly use up their entire available water supply. At least 50 per cent of the world's population — around 4 billion people — live under highly water-stressed conditions for at least one month of the year (Kuzma, et al., 2023). At the same time, industrial and domestic wastewater discharge, chemical runoff from agriculture and the improper management of other types of residues have resulted in the increase of nutrient loads and the proliferation of harmful substances, including heavy metals, persistent organic pollutants, and microplastics in water bodies worldwide. (United Nations, 2024; UNEP, 2023). Such pollution severely threatens aquatic and terrestrial ecosystems in addition to compromising the health and well-being of humanity society.[1]

In this context, the United Nations' Sustainable Development Goal (SDG) 6, Clean Water and Sanitation, occupies a significant place within the comprehensive 2030 Agenda for Sustainable Development. SDG 6 is dedicated to establishing accessible and enduring water and sanitation management for all. It addresses important dimensions of water and sanitation as basic health and economic enablers, including via wastewater treatment (WWT). SDG 6, Target 6.3 aims to improve water quality by 2030. This is to be achieved through reducing pollution, eliminating dumping, and minimizing release of hazardous chemicals and materials. It also entails halving the proportion of untreated wastewater being released and increasing recycling and safe reuse globally. Other targets include increasing water-use efficiency across all sectors by 2030 (Target 6.4) and protecting and restoring water-related ecosystems, including mountains, forests, wetlands, rivers, aquifers, and lakes (Target 6.6) (UN DESA, n.d.).

The need to adequately treat industrial wastewater pollution assumes particular significance in this context. Effective treatment of industrial wastewater can have a three-dimensional beneficial impact (United Nations, 2017). First, it can reduce pollutants in wastewater effluents enabling safe discharge into the environment (thereby supporting SDG 6, Target 6.6). Second, it can enable the reuse of treated wastewater, saving water in scarcity-prone regions (thereby supporting SDG 6, Target 6.4). In fact, it is estimated that globally only 11 per cent of domestic and manufacturing wastewater is currently being reused. Due to growing depletion of clean freshwater sources, the planned reuse of treated municipal wastewater is projected to grow by necessity from 271 per cent by 2030, from 7 to 26 billion m^3/year (UNEP, 2023). Third, certain treatment methods and technologies can enable the valorisation of sludge that is recovered from treated wastewater, further providing a means of value-addition and livelihood creation while reducing the volume of waste and oxygen-depleting matter entering the environment.

1 Globally, only 11 per cent of domestic and manufacturing wastewater is reused. Reuse of treated wastewater projected to grow 271 per cent (7 to 26 billion m^3/year by 2030) (UNEP, 2023).

Scaling up industrial WWT needs to consider the complexity of the sector. It involves integrating a diverse and often bundled array of goods ranging from filtration equipment, sensors and measuring equipment, some of which (e.g., solar-powered pumps) could also offer co-benefits such as energy efficiency. The types of technologies can be diverse depending on the stage of treatment and the specific characteristics of the effluent that needs to be treated, which could require varying and tailored levels of treatment. Recent advances also provide relevance to the use of other technologies like the Internet of Things (IoT), smart sensors, Artificial Intelligence (AI), and deep machine learning and nanomaterials (Tella, et al., 2025).

An additional complication associated with industrial WWT is unintended environmental consequences that could arise from the use of specific technologies. These include negative environmental externalities including greenhouse gas emissions if fossil-fuel energy is used to power WWT plants. Certain chemicals employed in WWT as flocculants, such as aluminium and iron salts, can also be harmful to the environment and to health if they are not properly treated or disposed of. For instance, aluminium-based flocculants can be highly toxic to aquatic life if they are disposed of improperly in rivers, lakes, or coastal waters. Indeed, high concentrations of aluminium in aquatic environments have been found to cause fish mortality and inhibit algal growth (Botté, et al., 2022). Exposure to heavy metals from industrial wastewater poses significant health risks, potentially leading to slowing growth and development, organ damage, cancer, neurological disorders, and, in severe instances, death when safe exposure thresholds are surpassed (Jyothi, 2020). Improper maintenance of WWT infrastructure can pose additional health risks (Tella, et al., 2025).[2] Existing wastewater collection and treatment systems are often outdated, insufficient, and unable to keep up with the increasing demand, particularly in developing countries, often the most affected by water scarcity (Vivas-Eugui and Dewar, 2025). Developing countries often face unique challenges in attracting and scaling up wastewater treatment such as lack of financing, technology and infrastructure investments and access to expertise (United Nations, 2024; United Nations, 2017). Attracting private sector investments requires sound regulatory frameworks at national and local levels that are adequately enforced. Well-designed public-private partnership models between the government and private sector firms can be an option to explore in this regard. A notable example is a SMEP project being implemented by the Kenya National Cleaner Production Centre (KNCPC), with financial support of FCDO titled "Enhancing Uptake of Resource Efficiency & Cleaner Production in Enterprises with Piloting Membrane Technology and Financial Services for Wastewater Treatment for the Textile, Tannery and Chemical Sub-Sectors in the Nairobi Rivers Basin". The project aims to contribute to industrial and institutional pollution reduction into the Nairobi River Basin. The intervention involves establishing a baseline pollution emission from enterprises, training, in-plant assessments, stakeholder engagement and partnerships to identify waste prevention and minimisation technologies and techniques (SMEP, 2024).

International trade can play a key role in filling this gap and providing developing countries with more affordable access to environmentally sound technologies (ESTs), including wastewater treatment solutions. These range from filtering machinery for water purification to chemicals such as anhydrous ammonia (UNEP, 2018; WTO, 2005). The size of the global water and WWT market is expected to grow at a compound annual growth rate (CAGR) of 6.5 per cent between 2025 and 2034 and will be worth over US$652.30 billion by 2034 (Globalnewswire, 2025). Trade can unleash untapped opportunities by facilitating access to and reducing the costs of water-related technologies and skills.

Environmental services also provide opportunities for businesses in developing countries (UNEP, 2018). Services are also an important enabler of WWT. WWT-related services are diverse and include engineering, design and construction, installation, maintenance, and operation. Service offerings can also involve integrated solutions offered either by domestic companies or foreign service companies established in a country via foreign direct investment (Mode 3 in Services Trade). Some WWT-related services such as consulting and monitoring can be provided either on-site or remotely (Mode 1) or through temporary presence of domestic or foreign technicians (Mode 4) (Sauvage and Timilotis, 2017).

2 For an in-depth discussion of the emissions tradeoffs of industrial WWT, based on business insights gathered by the SMEP Programme, please refer to Section 3.

↑ Image 1. Close-up of water samples from different stages of industrial wastewater treatment, illustrating pollutant reduction during the sedimentation process.

Pursuing export and import-related opportunities, however, comes with its own challenges. A key challenge arises from trade-related barriers that impede market access for WWT technologies and services. These barriers can include import duties, multiple product standards, government procurement restrictions and services barriers such as delays in visa approvals and licensing and qualification requirements for engineers and technicians (Bucher, et al., 2014; Bellmann and Bulatnikova, 2022). There is also a need for clearer identification of diverse wastewater treatment technologies within the World Customs Organization's (WCO) Harmonized Commodity Description and Coding System (HS), used by customs authorities for the application of border controls and customs duties and by trade officials in international negotiations.[3] One example of water filters-related HS codes where industrial and household water treatment systems and technologies are comingled include membrane, ion exchange pressure-reliant filters and more traditional, gravity-operated filters, are all bundled under the same HS code 842121 (UNCTAD, 2025b).

This brief explores the role of trade in facilitating access to affordable industrial wastewater treatment (WWT) solutions in developing countries. It does so through a combination of global data analysis and SMEP case study reviews outlining its potential for sustainability transitions and the business case for private-sector investment. Section 1 reviews the literature to discuss the urgent need for industrial WWT solutions and the challenges and opportunities of their adoption. Section 2 provides a mapping of key WWT technologies and related HS codes, analysing trends and barriers to global WWT trade, such as tariffs and non-tariff measures (NTMs). Section 3 presents business insights gathered from SMEP Programme grantees in East Africa and South Asia, focusing on market drivers and constraints and emissions reduction. Section 4 draws on evidence-based recommendations for policymakers.

3 Different goods and components required for WWT salutation are classified under diverse HS subheadings and may be subject to varying import duty rates, leading to challenges for companies procuring these goods.

2.

Trade in industrial Wastewater Treatment solutions

4 Insights gathered during interviews with SMEP Programme grantees.

2.1. Highly-traded industrial Wastewater Treatment technologies

A mapping

WWT solutions are tailor-made and typically involve complex bundles of capital goods. Technology requirements differ based on the type of effluents coming from specific activities conducted in factories (e.g., pharmaceuticals, tanneries, textile manufacturers or food processing sites), as well as on the end use of treated wastewater (e.g., safe discharge or reuse). All configurations entail some degree of technological complexity. Some goods, such as tanks and flocculants, tend to be easy to procure in local markets. Other critical equipment, including operating units and specialized components, are not always available locally and are frequently imported, especially in developing countries.[4] With applications at all stages of industrial WWT, this equipment ranges from dosing pumps and stations to control panels and treatment units (e.g., reverse osmosis). Each of these is traded internationally under specific tariff lines, both as integrated systems or as single parts and components (Figure 1, Table 1).

↓ Figure 1. Simplified flowchart of industrial Wastewater Treatment

Source: UN Trade and Development based on inputs from SMEP Programme grantees.

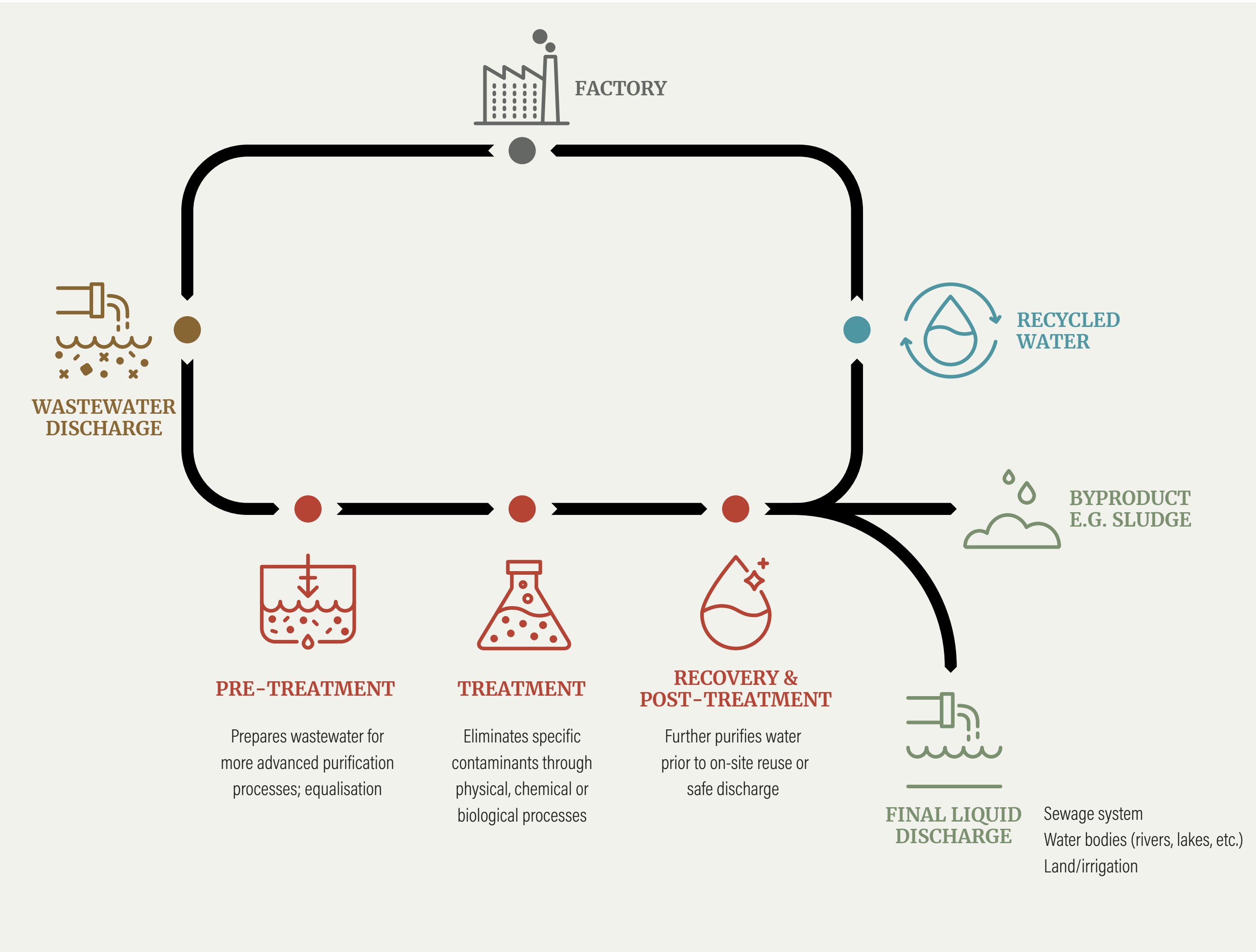


Table 1. Highly traded technologies for industrial WWT: operating units, components, and related HS codes

PRE-TREATMENT

Code	Integrated systems
842121	Coarse aeration
	Dissolved air flotation
	Electrocoagulation (EC)
	Filtration (MULTIMEDIA, TRICKLING)
	Oil, grease, and fat separators
	Three-stage filter units

Code	Parts and components
841350	Acid dosing pumps
841370	Lifting pumps
841391	Pump spare parts
841440	Compressors
841490	Compressor spare parts
841989	Cooling towers
842199	Coarse bubble air diffusers
853710	Control panels
902610	Flow meters
	Level sensors
	Weir flow meters
902730	Spectrophotometers
902789	pH meters

TREATMENT

Code	Integrated systems
842121	Advanced oxidation
	Biological reactors
	Chemical-physical treatment
	Clarifier scraping bridges
	Dissolved air floatation
	Electrocoagulation
	Ozonators
	Sludge dewatering
	Sonicators
	Ultrafiltration (UF)
	Filtration (MULTIMEDIA, TRICKLING)

Code	Parts and components
841350	Acid dosing stations
	Caustic dosing stations
	Hypochlorite dosing stations
841370	CIP pumps
	Feeding pumps
	Sludge pumps
	UF backwash/permeate pumps
841391	Pump spare parts
841440	Air compressors
841480	Air blowers
	Backwash blowers
841490	Blower spare parts
842199	Fine bubble air diffusers
847982	Mixers
853710	Control panels
902610	Flow meters
	Level sensors
	Venturi meters/orifice plates
902620	Pressure switches
902730	Spectrophotometers
902789	Dissolved oxygen meters
	pH meters
902790	Conductivity meters

RECOVERY & POST-TREATMENT

Code	Integrated systems
842121	Aeration
	Disinfection
	Filtration (MULTIMEDIA, TRICKLING)
	Nanofiltration
	Ozonators
	Reverse osmosis (RO)
	Ozonators
	Sonicators
	Ultrafiltration (UF)

Code	Parts and components
841350	Antiscalant dosing stations
	Dosing pumps
841370	CIP pumps
	Feeding pumps
	High-pressure pumps
	Permeate/concentrate pumps
841391	Pump spare parts
841440	Air compressors
841480	Backwash blowers
841490	Blower spare parts
842199	Cartridge filters
	Membrane housing and parts
	RO membrane elements
853710	Control panels
902610	Flow meters
	Level sensors
902620	Pressure switches
902789	pH meters
902790	Conductivity meters

↑ *Source: UN Trade and Development based on inputs from SMEP grantees.*

Note: The flowchart provides a simplified representation of industrial WWT solutions used in the manufacturing of textiles, veterinary products and agrochemicals, tanneries, and plastic recycling. It is not exhaustive, focusing exclusively on critical equipment (with corresponding HS codes) that is typically imported, based on data gathered from SMEP grantees. Acronyms are as follows: CEB (chemically enhanced backwash), CIP (clean-in-place). RO (reverse osmosis), UF (Ultrafiltration).

2.2. Trade trends and barriers

Over the past decade, global trade in industrial WWT technologies has outpaced all goods trade. In 2023, global exports of industrial WWT technologies were worth US$256 billion, of which US$12 billion were exports of integrated systems (as opposed to components?). While taking a minority share of exports in value terms, integrated systems serve diverse purposes in WWT and are the building blocks of WWT solutions. They range from dissolved air flotation equipment to reverse osmosis and electrocoagulation units. Their exports increased at a 5.2 per cent annual average rate in 2013-23, which is more than double the 2 per cent rate recorded by all goods exports in the same period (Figure 2).[5] This may be due to a rising demand for WWT solutions, driven by the fundamental necessity for clean water, better enforcement of local laws, and the increasing adoption of private standards in supply chains (e.g., Roadmap to Zero).

Most of the trade in industrial WWT technologies consists of a wide range of parts and components that are used in integrated WWT systems. In fact, global exports of these parts and components totalled US$244 billion in 2023, accounting for 95 per cent of industrial WWT technology exports.[6] Together with compressors and blowers (11 per cent), high-tech equipment, such as control panels and boards (34 per cent) and instruments for the analysis of physicochemical properties (8 per cent) are the most traded items, accounting together for over 40 per cent of these exports (Figure 3). While these parts and components are critical for industrial WWT, they also have wider applications. For example, control panels and boards are extensively used in manufacturing and process automation, as well as in energy management.

5 In 2023, China, Germany, the United States, South Korea, and Italy made up over half of WWT system exports (US$6.3 billion).

6 In 2023, Germany, China, the United State, Mexico, and Japan made up over half of WWT parts and components exports (US$127 billion).

7 This figure overestimates purely WWT-specific exports as several components such as pumps, control panels and compressors are used across various industries. Their applicability outside WWT solutions also explains why the value of their exports is disproportionately bigger than the value of exports of integrated WWT systems.

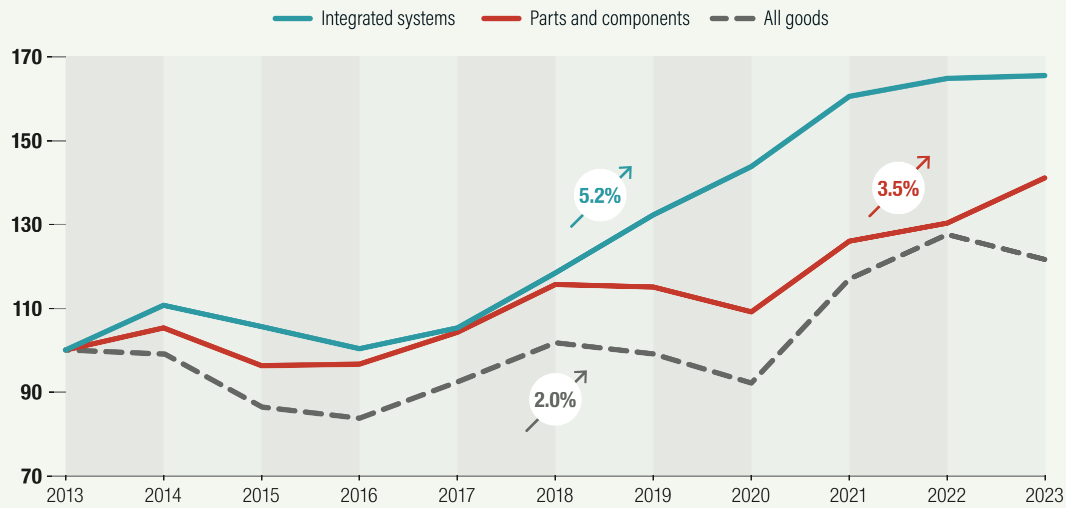


Figure 2. Global exports of industrial WWT technologies versus all goods
INDEX: 2013 = 100

Source: UN Trade and Development based on data from UN Comtrade (2025).

Note: To avoid time series bias, exports under code 902789 (introduced in 2022) were excluded. Goods and HS codes for "integrated systems" and "parts and components" are listed in the annex.

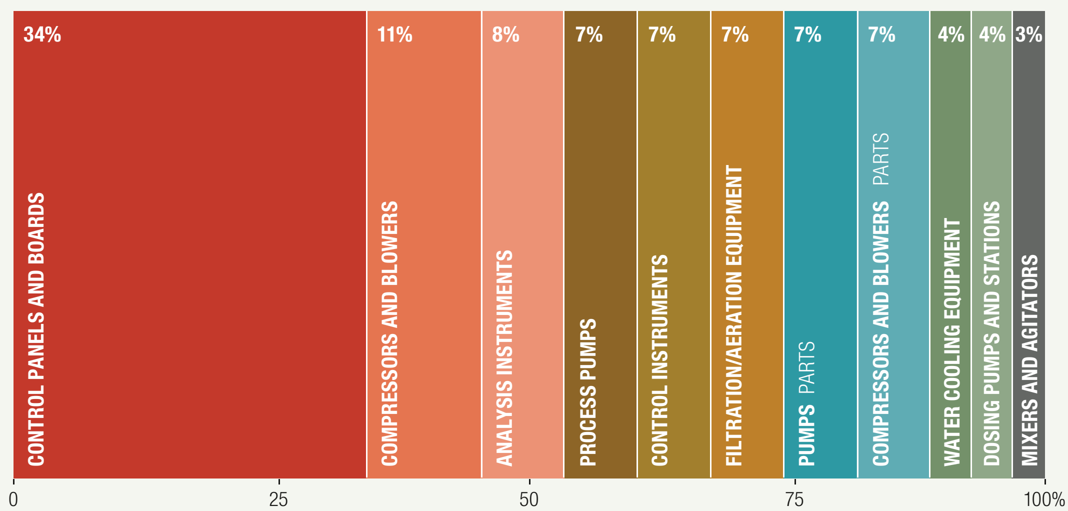


Figure 3. Global exports of industrial WWT parts and components, by product group
PER CENT, 2023

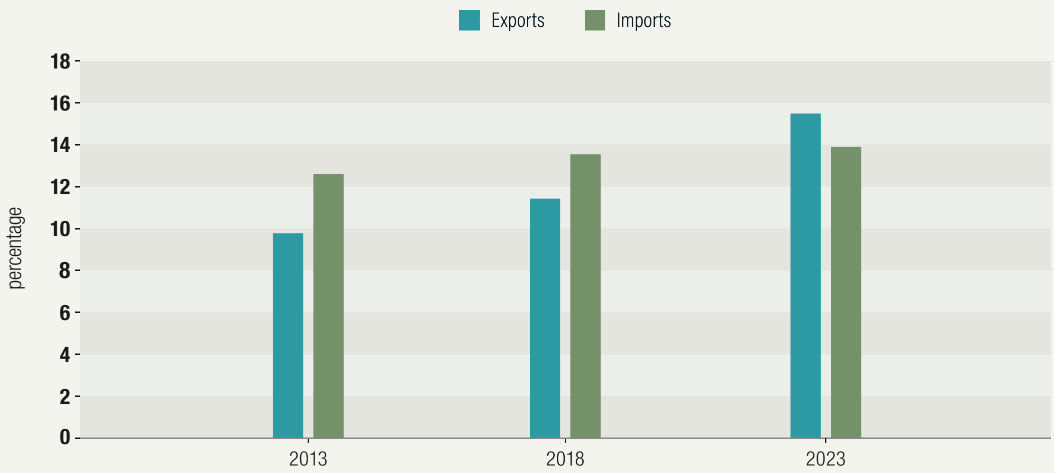
Source: UN Trade and Development based on data from UN Comtrade (2025).

Note: The annex lists goods and HS codes for the product groups analyzed. To align with Figure 1, exports under code 902789 (analysis instruments for physicochemical properties) were excluded, possibly underestimating their exports.

Not only did trade in industrial WWT technologies increase, but so did the proportion of this trade occurring between developing economies, commonly known as South–South trade. South–south trade has been growing and has extraordinary potential for global development. It can help countries with low technological capabilities and limited access to specialised skills break patterns of import dependency, while paving the way for new technology leaders to emerge. While only 10 per cent of exports of integrated industrial WWT systems originated from and were shipped to developing economies in 2013, this figure had increased to 16 per cent by 2023 (Figure 4). A similar, albeit less pronounced, trend can be observed in imports, where south–south trade increased from 13 per cent to 14 per cent in the same period.[8]

Although the market is signalling significant changes, important trade barriers still limit market access for industrial WWT solutions across the supply chain. On average, most-favoured nation (MFN) tariffs applied to the imports of these goods tend to be higher for individual parts and components (Figure 5). Compressors and blowers are affected by the highest tariffs on average, at 9.4 per cent, with a minimum rate of 7.1 per cent and a maximum rate of 11.5 per cent. Conversely, parts of pumps face the lowest tariffs, with an average applied rate of 6.2 per cent. Duty exemptions are a relatively common practice. For example, analysis instruments for physicochemical properties enjoy 100 per cent duty-free treatment in 62 per cent of instances, making them the WWT technologies most exempt from duties. Integrated systems, which are subject to relatively low tariff rates of between 5.7 per cent and 7.4 per cent, benefit from 100 per cent duty-free treatment in 42 per cent of cases.

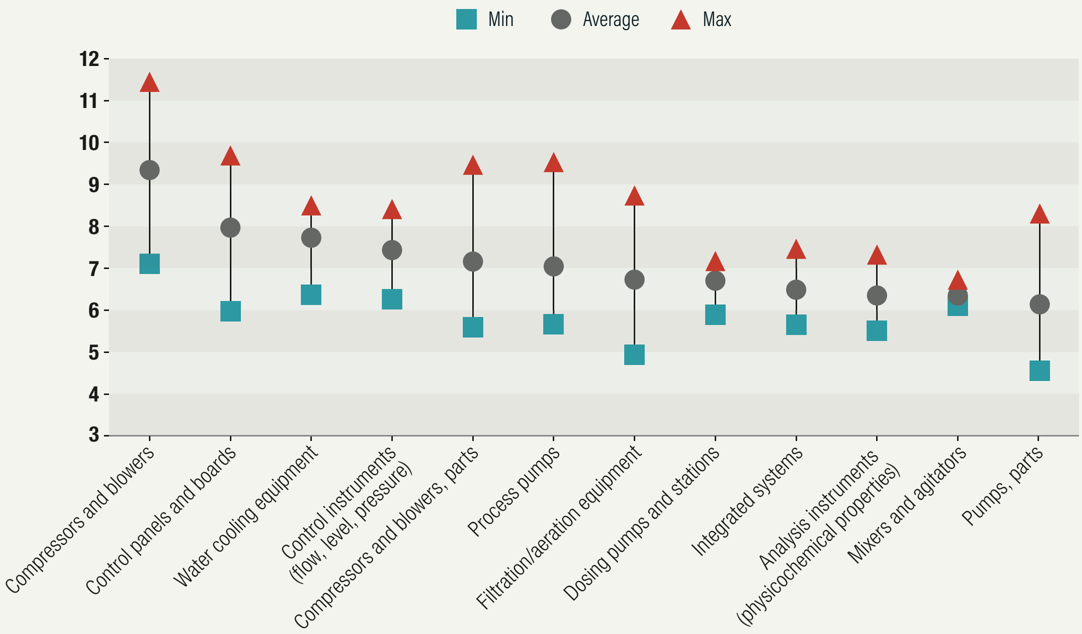
8 When the analysis is conducted excluding China - the world's top exporter of integrated WWT systems and a country officially classified by international bodies as developing - the trend is maintained for south–south exports, which show a moderate increase from 6 per cent to 7 per cent of the total between 2013 and 2023. However, the trend is not maintained for south–south imports, whose weight on all imports declined from 7 per cent to 5 per cent in the same period. This suggests a prominent role played by China in this trade.



← Figure 4. **South-South trade in integrated industrial WWT systems, by trade flow**
PER CENT, 2023

Source: UN Trade and Development based on data from UN Comtrade (2025).

Note: South-South trade refers to trade between developing economies, including China, as a share of total trade. Goods and HS codes analyzed are listed in the annex.



← Figure 5. **Average most-favoured nation (MFN) tariff applied to industrial WWT technologies**
PER CENT, 2024

Source: UN Trade and Development based on data from WTO Tariff Download Facility (2025).

Note: If 2024 data is unavailable, the latest year (2022–2023) is used. Preferential rates from trade agreements (FTA, regional, etc.) are excluded.

Industrial WWT technologies also face several non-tariff barriers, including technical barriers to trade (TBT) and sanitary and phytosanitary (SPS) measures. SPS measures have become particularly prevalent in recent years as 28 such measures covering integrated systems (HS code: 842121) were notified to the WTO in 2024 alone. These measures usually impose restrictions on the import and transit of animal and plant products, as well as associated equipment such as water treatment systems to prevent the spread of diseases and pests. TBTs, on the other hand, are less frequent but still include important requirements. These include safety and performance standards that specifically target water treatment technologies, such as filters and purifiers. They detail requirements for water quality testing and compliance with national and international standards (e.g., NSF/ANSI), as well as certification processes (e.g., product or type-approved inspection) to ensure the effective removal of contaminants.[9]

9 UN Trade and Development analysis based on data ePing SPS&TBT platform (2025).

↑ Image 2. Integrated wastewater treatment (WWT) tanks in an industrial facility. Integrated systems, ranging from dissolved air flotation to reverse osmosis and electrocoagulation units, are essential building blocks of WWT solutions and a growing part of global trade.

3.

Industrial wastewater treatment in East Africa and South Asia*
Case study

* Note: This section presents firm-level insights from field visits. While efforts were made to ensure accuracy, some information remains unverified and may be anecdotal or self-reported.

In climate-stressed developing countries, the treatment of industrial wastewater by SMEs highlights the importance of water in enabling economic activity and promoting circularity. Projects supported by the SMEP Programme in Bangladesh, Kenya and Pakistan demonstrate how value can be created from wastewater effluent while addressing urgent environmental and health concerns. These solutions combine various technologies, such as reverse osmosis and ultrafiltration, which work together to significantly mitigate pollution. Benefits range from the removal of microplastics and heavy metals from treated wastewater to reduced energy consumption and the extraction and recovery of salts for reuse (Table 2).

↓ Source: UN Trade and Development based on interviews with SMEP Programme grantees.

Table 2. SMEP Programme interventions in industrial WWT in Bangladesh, Kenya, and Pakistan

Country	Sector	Lead grantee	Technology	Pollution mitigation benefits
Bangladesh	Textiles	Panta Rei Srl PRIMARK H&M GRUNDFOS FAKIR KNITWEAR WATERAID	Ultrafiltration (UF). Reverse Osmosis (RO).	WWT and water recovery for reuse in production processes. Aim: Zero Discharge of Hazardous Chemicals (ZDHC).
		Solidaridad Network Asia QSTONE CAPITAL B.V. LENNTECH B.V. KINGSLEY ENGINEERING KWR RESEARCH INSTITUTE	Electrocoagulation, followed by Ultrafiltration, Reverse Osmosis, Crescendo unit (evaporation of brine from sludge). Pusher centrifuge (extraction and recovery of salt for reuse).	WWT and water recovery for reuse in production processes. Aim: Zero liquid discharge (ZLD).
Kenya	Veterinary products Agrochemicals Tanneries	Kenya National Cleaner Production Centre (KNCPC) KANKU KENYA LTD. FINTECH FRONTIERS	Hybrid ultrafiltration membrane. Systems include venturi aeration, bioreaction, coagulation/ flocculation, clarification, filtration, chemical disinfection & clean-in-place (CIP), dewatering and desludging.	Lowering of biological oxygen demand (BOD) and chemical oxygen demand (COD) to meet regulated national standards.
	Plastic recycling	Mr Green Africa	Hybrid ultrafiltration membrane.	Removal of micro plastics and heavy metals from treated wastewater.
Pakistan	Textiles	Northumbria University ASTON UNIVERSITY BAHUADDIN ZAKARIYA UNIVERSITY, NATIONAL TEXTILE UNIVERSITY ACCESS GROUP OF COMPANIES SE DROP	Molecular Distortion Technology (electrocoagulation). Solar evacuated tube collectors to facilitate water reheating.	WWT and water recovery for reuse in production processes. Aim: Zero Discharge of Hazardous Chemicals (ZDHC).

3.1. Market drivers and constraints
Evidence from the Nairobi Rivers Basin

3.1.1. A complex business

Interviews with SMEP grantees confirm the complexity of industrial WWT. The level of ambition and the necessary investment are directly tied to the type of effluent being treated and the treatment's goal (safe discharge or reuse). Tannery effluents, for instance, are notoriously intricate due to the diverse processes involved, such as soaking and liming. These effluents can vary greatly in composition, ranging from alkaline and acidic streams to those containing heavy solids, hairs, and various organic compounds. This makes them more challenging to treat than textiles effluents, where synthetic particles are the primary pollutants. Local conditions can also play a role as they influence the overall quality (and treatment needs) of waste streams used as raw materials in recycling and dictate the sophistication and capital expenditure required for the treatment system. This is the case for plastic recycling in coastal areas. There, due to the low availability of freshwater and high consumption of bottled water, waste streams tend to contain a high number of PET bottles, which are relatively easy to wash as they do not contain fats or oils.

Companies address this complexity by adopting tailor-made solutions that integrate various technologies, often implemented modularly and progressively over time (see also Table 1). Single technology such as membrane filtration, is rarely sufficient on its own and must be coupled with other processes to achieve desired cleaning results. The interviewed companies report that individual technologies are relatively standardized, and that the "true art" lies in their combination and the judicious use of chemicals. This is often developed through a collaborative learning process with suppliers. One grantee reported starting with a smaller, locally sourced solution worth around US$50,000, which was then progressively upgraded with high-end technologies imported from abroad (China, Germany). This iterative process is crucial as effluent quality can fluctuate significantly, making solution development "a process of trial and error" rather than a straightforward path.

← Image 3. Membrane filtration tank at an SME wastewater treatment facility. SMEP projects in Bangladesh, Kenya, and Pakistan combine technologies such as reverse osmosis and ultrafiltration to clean industrial effluents and recover resources.

3.1.2. Drivers and constraints

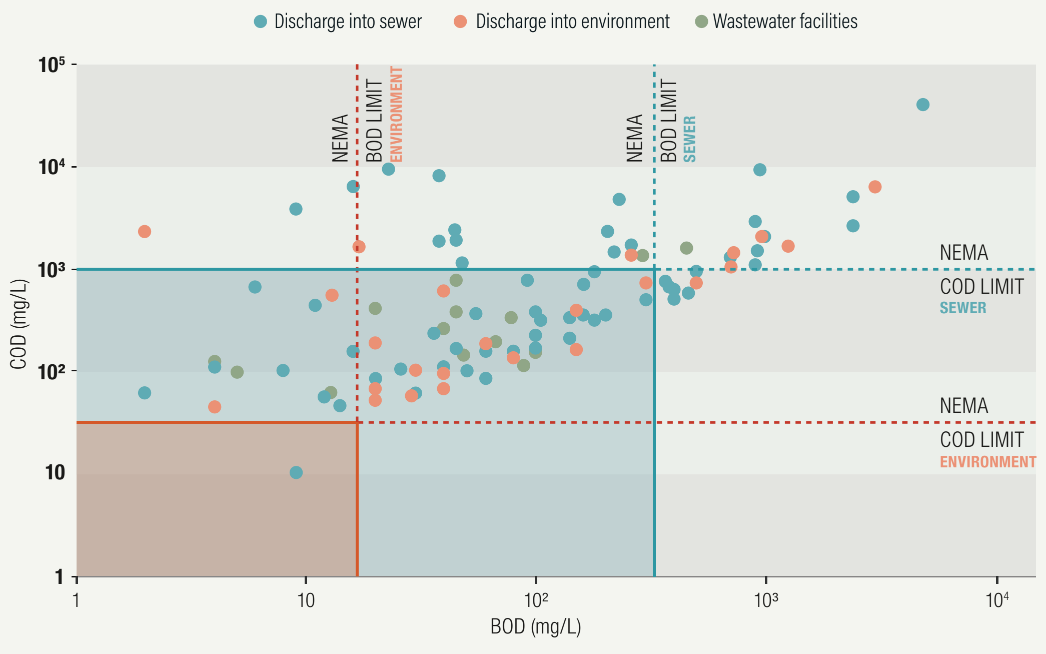
Setting up and running WWT solutions entails substantial costs, which extend beyond the initial investment to include operational costs such as energy consumption and chemical supplies. One SMEP grantee in Kenya reported that the operating expenses (OPEX) of water treatment (chemicals, energy), excluding repair and maintenance costs, amount to 138 KES (approximately 1.1 US$) per cubic metre. In addition, some system integrators and suppliers may inadvertently create vendor lock-in by pushing their proprietary chemical mixes, which tend to be more expensive, thereby exacerbating the financial burden on companies. Industrial WWT also generates substantial amounts of sludge. In the absence of secondary value addition (e.g., use as fertilizer or construction material), this sludge can be expensive to dispose of. Maintenance and repairs can also be significant cost factors.

These cost barriers are further exacerbated by challenging framework conditions, particularly the widespread absence of local authorities operating centralized municipal WWT facilities. This forces individual companies to bear the entire responsibility for WWT to comply with regulations. This is the case in the Nairobi Rivers Basin, where local companies must meet stringent requirements for effluent discharge, either through their own effluent treatment plants (ETPs) or through private sewage companies (KNCPC, 2025 forthcoming).

Non-compliance is limited in the case of discharge into sewers, ranging from 14 per cent to 34 per cent of examined cases depending on the parameters assessed, whereas it spikes to between 70 per cent and 97 per cent of examined cases for discharge into the environment (e.g., through waste handlers, into nearby river streams, lagoons or ponds) (Figure 6). This suggests that local companies are likely to find it more challenging to comply with the more stringent regulatory requirements for direct environmental discharge, due to the potentially higher technical and financial investments needed, as well as the rigour of enforcement. In some cases, companies were also found to invest in ineffective solutions.

Compliance is the main driver of WWT investment in Kenya. This may be due to the increased enforcement of local environmental law, such as the Environmental Management and Coordination Act (EMCA), and the greater vigilance by regulatory bodies, such as the National Environment Management Authority (NEMA).[10] Grantees confirm that adherence to NEMA effluent discharge standards, including limits on BOD, COD, and heavy metals, is usually monitored via quarterly or unannounced testing. They also mention the "regulatory relief" experienced by companies investing in WWT solutions, as this enables them to obtain an effluent discharge licence and pass the required tests.

10 The Kenya Environmental Management and Coordination Act (EMCA), No. 8 of 1999, Rev. 2012, regulates effluent discharge from industrial activities. Its Fifth Schedule provides standards for effluent discharge into public sewers, while its Third Schedule lists standards for discharge into the environment, including limits for BOD, COD, and heavy metals. Full text available at: https://kenyalaw.org/.



← **Figure 6.** Sampling of industrial wastewater discharges into in the Nairobi Rivers Basin

Source: UN Trade and Development analysis on data collected by the Kenya National Cleaner Production Centre (KNCPC).

↑ Image 4. Industrial wastewater treatment generates substantial amounts of sludge. Without secondary uses such as fertilizer or construction material, disposal can be costly for companies.

While the willingness to invest varies significantly across companies, achieving compliance can also form part of a virtuous approach, with consistent water quality monitoring leading to a deeper commitment to environmental stewardship. Indeed, some of the companies interviewed consider compliance as a "low-hanging fruit" – an initial, attainable step towards broader environmental responsibility. They do not view WWT investment as a strict economic decision, but rather as an opportunity to shift the mindset towards resource efficiency and enable applications to ISO certifications such as ISO 9001 and ISO 14001, thereby adding to organizational value. This could enhance financial performance, brand reputation and competitive advantage, as well as improving staff morale (Feng and Wang, 2016; Eccles, Ioannou and Serafeim, 2014).

According to some grantees, the investment bias towards compliance may also originate from a lack of incentives to treat water beyond regulatory requirements. While a demand exists for treated wastewater, which is more suitable than freshwater for some industrial applications, such as construction, the market does not adequately price it. In Nairobi, the price of freshwater for industrial use ranges from 67 to 80 KES (equivalent to approximately 0.5 to 0.6 US$) per cubic metre. This is significantly lower than the estimated cost of wastewater treatment, which is around 140 KES.[11] This discourages market players from utilising treated wastewater or investing in advanced water treatment solutions, resulting in effluent being treated only to the extent necessary for compliance.[12]

Limited access to finance is also a large obstacle to investing in WWT solutions in Kenya. SMEP grantees report that the unavailability of financial resources is the main obstacle to adopting expensive water technology solutions. Banks are often reluctant to fund these projects as they are not revenue generating and can be perceived as a burden on a company's cash flow. On a positive note, there is a high awareness of the issue and private companies such as Fintech Ltd. are working on developing guiding frameworks for commercial banks to enable matchmaking (Box 1). Beyond financial limitations, implementing WWT solutions requires a significant cultural shift within organisations, necessitating strong management commitment and workforce buy-in. This cultural transformation often demands considerable time and resources dedicated to change management, including training programmes.

11 The Water Services Regulatory Board of Kenya regularly updates water tariffs in accordance with Section 72(1) of the Water Act 2016. The current tariffs can be accessed on the website of the Nairobi City Water and Sewerage Company: https://www.nairobiwater.co.ke/water-tariffs/.

12 For an overview of water tariff structures in sub-Saharan Africa, see: SIWI (2020).

Box 1. Fintech's framework to catalyse effluent treatment plant (ETP) financing for SMEs in Kenya

While commercial banks are increasingly committed to sustainable finance under ESG mandates, manufacturers often lack the capacity to present bankable business cases for Effluent Treatment Plants (ETPs), and financial institutions lack appropriate credit appraisal models for these investments. Furthermore, ETPs are often viewed as generating environmental rather than economic returns, making them less attractive for traditional financing. The funding gap is larger for small and medium-sized enterprises (SMEs), which collectively contribute significantly to water pollution but are not typically served by commercial banks for these investments.

To address this, Fintech Frontiers, as part of the Scaling Resource Efficiency and Cleaner Production (RECP) in the Nairobi Rivers Basin project in the framework of the SMEP Programme, is developing a guiding framework for market players to catalyze financing for industrial ETPs. This involves creating a Financial Impact Measurement Model (FIMM) to help manufacturers evaluate project viability and prepare bankable proposals, and a Credit Model (CM) to guide commercial banks in their credit appraisal of ETP projects. Both models incorporate non-traditional evaluation elements such as the estimated cost of non-compliance to provide a uniform basis for understanding ETP unit economics. So far, Fintech has engaged with five large commercial banks and the Kenya Bankers Association, who have reacted positively to the initiative and are willing to support the project, including with financing for the model. The project also aims to include Microfinance Institutions (MFIs) and Savings and Credit Cooperatives (SACCOs) in the process.

Future activities include training bank officials such as credit officers and company finance personnel, facilitating matchmaking sessions between polluting industries and financial institutions, and strengthening policy dialogue with government officials (e.g., NEMA), local governments, and sector associations. The expected results include increased access to finance for ETPs, enabling companies to meet and exceed regulatory compliance while promoting circular water use and greater resource efficiency. Following the promising results of a pilot project, the model will prioritize locally assembled ETP technologies, which offer up to 60 per cent cost savings compared to imported alternatives and potential for import substitution.

↑ *Source: Fintech (2025, forthcoming).*

Insights gathered from SMEP grantees outside of Kenya also suggest that international brands, including fast fashion retailers, can play a significant role in facilitating investment in (and securing finance for) industrial WWT solutions at suppliers. These brands not only support the adoption of WWT solutions but also investment in broader factory improvements, such as low-carbon initiatives and social safeguards. The aim is to transform select facilities into showcases for best practices within their network of shared suppliers. A key aspect of this is presenting a compelling business case for investing in advanced WWT. As these brands often must comply with more stringent international standards than local ones, such as EU regulations, it is strategically beneficial for them to participate in financing sophisticated WWT solutions. This ensures regulatory compliance, demonstrates commitment to sustainability, and fosters a more resilient supply chain.

3.1.3. The role of international trade

Against this backdrop, interviews with grantees confirmed that international trade can facilitate the acquisition of WWT technologies and their integration into comprehensive solutions. However, the evidence is mixed. While some essential components, such as pumps, sensors, and valves, are imported, a sizeable proportion of equipment, including tanks and conveyors, is manufactured locally. Grantees indicate that there are "good capabilities for local technological fabrication". Although foreign companies (or their subsidiaries in the country) orchestrate the design of solutions and systems integration, some local companies assemble technologies sourced from abroad. A key challenge is the lack of independent experts who can offer impartial advice, since many consultants have ties to suppliers and prioritise selling their own products, such as chemicals.

Import duties and tariffs present a significant barrier. While some companies indicated that they benefited from duty exemptions, others reported facing high import duties under the East African Community's Common External Tariff (CET). These costs are further inflated by a Railway Development Levy (2 per cent), an Import Declaration Fee (2.5 per cent) and VAT (16 per cent), meaning that the total tax for importing WWT technologies can be as high as 70 per cent.[13] Grantees also report that integrated solutions that qualify for duty exemptions under certain tariff lines are easier to import than single parts or components (e.g., compressors), which face high tariffs. For example, a water treatment unit might incur a 10 per cent import levy, but this could be avoided if the entire solution were imported as a single "recycling plant". This suggests inconsistencies in tariff schemes, which may disincentivize the import of parts essential for maintenance and limit the transition to more sustainable business models. Inconsistencies include the absence of a clear classification for "green" technologies and a general bias towards finished goods/systems over components.

Non-tariff measures (NTMs), such as pre-approval requirements, shipping documentation and mandatory pre-shipment inspections by third parties, can result in fines if not complied with. Bureaucratic hurdles are further compounded by permits and licences that expire and the need to re-import the same spare part, creating a cyclical administrative burden that is particularly onerous for consumables (e.g., chemicals). Some companies also report a lack of clarity and uncollaborative behaviour from government entities, who sometimes categorise WWT technologies under higher tariff merchandise groups.[14]

3.2. Emissions trade-offs
Evidence from Fakir Knitwear, Bangladesh

The textile industry is responsible for around 20 per cent of global clean water pollution from dyeing and finishing products, accounts for 3.5 per cent of water scarcity, 5 per cent of nutrient overload that disrupts marine and freshwater ecosystems and nearly 3.5 per cent of global greenhouse gas (GHG) emissions (European Parliament, 2020; Circular Economy, 2024). Considering the entire textile supply chain, textile manufacturing contributes the highest (around 41 per cent) of greenhouse gas (GHG) emissions, followed by the consumption phase (24 per cent). Given that the impacts took place during manufacturing (e.g., pollution to water and atmosphere), the SMEP pilot project at Fakir Knitwear showcases an exemplary opportunity for resource conservation through reuse of wastewater and avoidance of GHG emissions.

The GHG emissions in the textile manufacturing process are accounted for by utilising energy, resources (e.g., water) and chemicals for processing. Depending on the manufacturing countries and their local contexts, water used in the textile process is sourced from the local water supply system, surface water (e.g., rivers), or groundwater. Also depending on the quality of the extracted groundwater (e.g., level of iron, alkaline, etc), it often needs pre-treatment, like groundwater softening to achieve the required water quality for textile processing. The need for pretreatment will also be dictated by the type of textile manufacturing (i.e. sourcing, printing, dyeing, and finishing). Thus, the wastewater generated through this textile processing requires necessary treatments before releasing to the environment (rivers, lakes, or local sewerage system).

13 More information can be found in the text of the Republic of Kenya's Finance Bill 2024 (https://www.kenyalaw.org/kl/fileadmin/pdfdownloads/bills/2024/TheFinanceBill_2024.pdf) and the East African Community's Common External Tariff 2022 (https://www.eac.int/documents/category/eac-common-external-tariff) The 70 per cent figure was disclosed by a grantee in an interview and could not be verified.

14 This is also supported by insights gathered from other SMEP Programme grantees in other countries.

The GHG emissions reductions from the WWT have been considered under three scenarios aligned with and meeting the local regulatory requirements (as shown in Figure 6):

- Scenario 1 (S1): Discharge without any treatment (Non-compliant Scenario),
- Scenario 2 (S2): Discharge after the secondary treatment (Baseline Scenario),[15] and
- Scenario 3 (S3): Discharge after the advanced treatment (SMEP Project Scenario).

The GHG emissions reduction and resource recovery benefits during the manufacturing of textiles could be achieved by considering the following approaches (as shown in Figure 7):

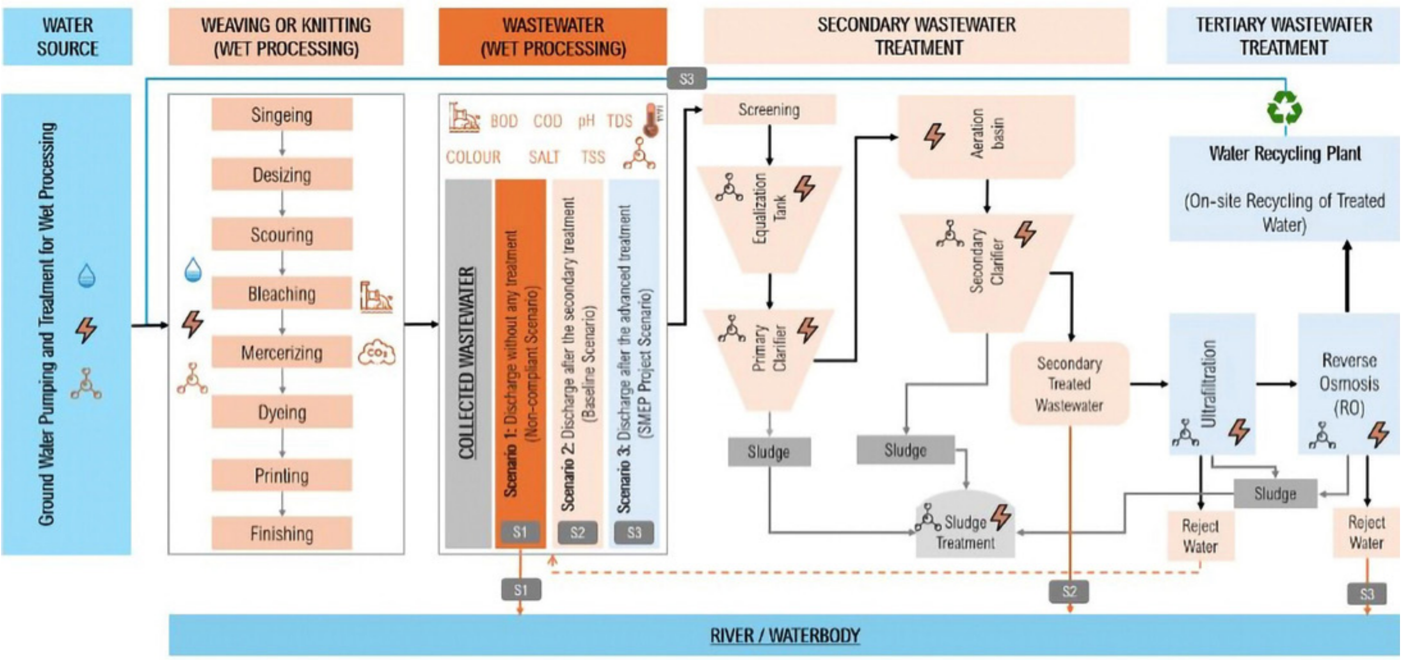
i. Reduce energy demand by improving energy efficiency and sourcing on-site renewable energy (e.g., solar PVs, bioenergy from sludge using Anaerobic Digestion).

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. Reduce water demand by recycling and reusing treated wastewater for on-site applications and improve water efficiency in wet processing.

iv. Reduce chemical demands by optimising chemical use and recovery of chemicals through advanced chemical recovery options.

15 The current baseline scenario assumes 100 per cent wastewater is treated and meets the local wastewater discharge standards and quality requirements, when released to the water body, which may not be the actual practices by the local industry.



Potential Opportunities for the Reduction of Resource Use and GHG Emissions:

	Reduction of water demand by recycling of treated wastewater for on-side application and improving water efficiency in the wet processing		Reduction of chemical demands by optimising chemical uses and recovery of chemicals through advanced chemical recovery options
	Reduction of energy demand by improving energy efficiency and sourcing of on-site renewable energy (e.g. solar PVs, bioenergy from sludge)		Recovery of heat from the weaving and knitting process and from the wastewater through heat exchangers (e.g. Shell-and Tube or Plate)

↑ Figure 7. Potential opportunities for the reduction of material use and GHG emissions

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

← Image 5. SMEP-supported technologies, including ultrafiltration and reverse osmosis, enable water recovery and reuse in garment production, reducing pollution, groundwater extraction, and greenhouse gas emissions.

3.2.1. GHG Emission Reduction through Wastewater Treatment at Fakir Knitwear

The Fakir Knitwear Project in Bangladesh aims to promote water circularity in garment factories and pilot a business case for scaling up improved WWT and reuse in brands' supply chains. Panta Rei is deploying advanced WWT and water recovery systems through ultrafiltration and reverse osmosis (RO), at Fakir Knitwear. Simultaneously, Grundfos is enhancing the efficiency of four 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.

The annual water consumption and the generated wastewater of Fakir factory is 432,000 cubic meters (m^3), which is expected to remain the same in the future. In the non-compliant scenario (S1), the entirety of the wastewater is assumed to be released to the nearby water body without any treatment. For the baseline scenario (S2), wastewater is assumed to meet the minimum water treatment requirements (of Bangladesh) without any water reuse; and recycling provisions and the SMEP Project Panta Rei's advanced WWT (SMEP Project Scenario S3), where half of the wastewater will be reused in the production process. The remaining 50 per cent treated wastewater will be released to the water body.

Thus, during the entire SMEP program (6 years of WWT in operation), around 2,592,000 m^3 of wastewater will be generated at Fakir Knitwear. The SMEP pilot project will treat the generated wastewater using Panta Rei's advanced WWT technologies. The SMEP pilot project would save around 1,296,000 m^3(50 per cent) of the wastewater by enabling reuse after advanced treatment. The emission reduction opportunities have been considered by savings from (a) wastewater discharge (e.g., less pollution and volume), (b) groundwater pumping (both by withdrawing less and using less energy) and (c) groundwater softening (almost half of the demand).

This recirculation of treated wastewater into the production halves the demand for the groundwater pumped for factory use. This sharply reduces electricity demand for pumping (the emission factor of Bangladesh's grid electricity is ~0.61 $kgCO_2$/kWh). 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 hard, requiring lime or other softening agents) before the wet processing.

The SMEP project not only save the wastewater 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 18kg CO_2e/m^3(baseline scenario) to 30kg CO_2e/m^3 (non-compliant scenario) of GHG reduction opportunity for treating wastewater generated in the textile industry in Bangladesh using advanced WWT.

16 Hossain, L., Sarker, S. K., & Khan, M. S. (2018). Evaluation of present and future wastewater impacts of textile dyeing industries in Bangladesh. Environmental Development, 26, 23-33.

↑ Figure 8. Climate and waste benefits of advanced WWT in Bangladesh's textile industry

3.2.2. The Sectoral GHG Reduction Opportunities

As a global hub for textile and readymade garments manufacturing, Bangladesh hosts around 1,430 textile mills and 240 dyeing, printing, and finishing mills (BIDA, 2024). To contextualise the sectoral benefits, textile mills were expected to produce around 349 million m^3 of wastewater in 2021,16 and if 25 per cent of the wastewater is treated by the advanced WWT, similar to Fakir Knitwear, that would avoid GHG emissions around 1,555,218 tonnes (S2, considering 18kg CO_2e/m^3) to 2,643,116 tonnes (S1, considering 30kg CO_2e/m^3) each year (representing 4 per cent to 7 per cent of NDC's emissions reduction targets by 2030) and save around 43,625,000 m^3 precious groundwater in Bangladesh (Figure 8).

In addition to water reuse and avoided emission reductions, the pilot project also offers economic benefits by saving electricity and softening chemicals (mostly imported).

Given the environmental benefits (reduction of pollution and GHG emissions) of the WWT SMEP's pilot project, there is an excellent opportunity for regional and global relevance to replicate similar approaches to other top textile-producing in the region. Based on SMEP's project investment and potential GHG emissions reduction potential, it accounts that for 1$ invested in the advanced WWT, it would yield around 30.3kg/US$ or 0.03 tonne/US$ (S2) and 51.5 kg/US$ or 0.05 tonne/US$ (S1) emissions.

There are several initiatives to explore by the relevant stakeholders to address the financing challenges described above. These include the international climate and development financing mechanisms such as the Green Climate Fund (GCF)[17] and Climate Investment Funds (CIF),[18] national governance and institutional mechanisms such as Bangladesh Bank Green Transformation Fund (GTF),[19] various public-private-partnerships (PPPs),[20] private sector and technical capacity building mechanisms, such as Climate Technology Centre and Network (CTCN).[21]

Advanced WWT technologies address pollution treatment and control while reducing the GHG emissions, thus, decarbonising industrial WWT delivers significant environmental, social, and economic benefits by improving water quality, conserving resources (e.g., water, softening agents, etc.), reducing pollution, and enabling energy saving. It also lowers operational costs, supports green job creation, enhances public health, and opens new potential revenue streams through carbon credits and other innovative financing mechanisms.

However, several trade-offs must be addressed. High upfront costs, technical complexity, and shortages of skilled labour—particularly in the Global South—can hinder implementation. Regulatory gaps and competition for finite resources may also pose barriers. Addressing these challenges requires coordinated and coherent policies, innovative financing mechanisms, and capacity-building to ensure inclusive and effective transitions.

17 More information can be found at https://www.greenclimate.fund/.

18 More information can be found at https://www.cif.org/.

19 More information can be found at https://www.greenfinanceplatform.org/policies-and-regulations/bangladeshs-green-transformation-fund-gtf/.

20 More information can be found at https://www.pppo.gov.bd/.

21 More information can be found at https://www.ctc-n.org/.

4.

Conclusions and recommendations

Given the urgency to address climate change and increasing water scarcity, industrial WWT offers multifaceted benefits for ecosystems, economies, and human well-being. It is a pivotal element in addressing the triple planetary crisis of climate change, pollution, and biodiversity loss. In fact, effective WWT can significantly reduce pollutants, enable water reuse in scarcity-prone regions, and facilitate the valorisation of recovered sludge, thereby fostering a more circular economy and contributing to resource efficiency.

However, comprehensive case studies from Kenya and Bangladesh highlight several challenges in the adoption and scaling of industrial WWT solutions, including high upfront and operational costs, lack of appropriate financing mechanisms, absence of robust public infrastructure, and complex trade barriers such as tariffs and non-tariff measures. To overcome these hurdles and fully harness the potential of WWT for sustainability transitions, a concerted effort involving policy makers, financial innovation, and international cooperation is essential. Addressing these barriers will not only facilitate compliance with environmental regulations but also foster a deeper commitment to resource efficiency and sustainability.

A number of recommendations can be extracted from these analyses to guide the joint efforts of governments, the private sector, and international organizations in pursuing a water-friendly and resource-efficient global economy at national, regional, and multilateral levels:

GOVERNMENTS

- Integrating water-related circularity principles (e.g., wastewater reuse, sludge-to-energy) into national climate (including NDCs), trade and industrial policies to support resource-efficiency and achieving GHG reduction targets.
- Developing a mix of supportive policy instruments such as performance-based green subsidies, tax incentives (e.g., rebates, credits), environmental compliance bonds for industrial facilities and green tariff and NTM schemes (that can be included in upcoming NDCs); concurrently, streamline related inspections, permits, and procedures.
- Consider facilitating access to impartial advice and expertise for the private sector that can enable them to choose from a range of technology solutions and providers, both domestic and foreign, most suited to their needs and priorities,
- Address tariff inconsistencies and escalation, particularly between integrated WWT systems and their parts and components, to reduce import costs and incentivize technological upgrades;
- Review and address non-tariff barriers that impede timely and cost-effective access to WWT systems, technologies and services including by introduction of adequate trade facilitation measures at the border.
- Promote policy dialogue, both within government and across government agencies at different scales and with the private sector, to raise awareness about the benefits of WWT and related technology uptake beyond mere regulatory compliance.
- Accelerate public-private partnerships (PPPs) among government agencies, commercial banks, and business support organisations to facilitate financing, including through blended and other innovative financing mechanisms and use of carbon markets to finance effluent treatment plants (ETPs).

- Accelerate the development of green industrial zones, which enable co-investment in the infrastructure of advanced WWT in industrial clusters to reduce cost burdens.
- Introduce certification schemes for WWT technology and service providers to ensure fair pricing, promote interoperability, and prevent technological lock-in (e.g., for chemical supplies and equipment).
- Introduce or reform water pricing schemes to incorporate wastewater pricing, thereby incentivizing industrial WWT and promoting the use of recycled water over freshwater in non-essential applications (e.g., road washing, construction).[22]
- Develop national digital dashboards for monitoring and certifying pollution and emissions reduction targets linked to performance-based subsidies and their impact.

PRIVATE COMPANIES (INCLUDING BRANDS & TECHNOLOGY PROVIDERS)

- Encourage and enable public-private partnerships (PPPs) for co-investment models with technology providers and integrate industrial WWT and GHG reduction into supplier sustainability scorecards and procurement criteria.
- Support technology adoption and innovation by collaborating with international and local technology providers to share knowledge, build local capacity and find affordable solutions.
- Enable consortia to share knowledge and technologies and build local capacities to support South-South partnership and North-South collaboration for technology transfer, including exploring how carbon market could further make WWT affordable.
- Ensure WWT is fully embedded in corporate sustainability strategies and targets beyond compliance. Accordingly, invest in change management and awareness-raising initiatives (e.g., staff trainings) to secure management buy-in and employee support.
- Partner with clients in joint water management projects (e.g., co-investment, cost-sharing), particularly in water-stressed areas and water-intensive sectors (e.g., textiles).

INTERNATIONAL AGENCIES AND DONORS

- Support reforms of multilateral frameworks for customs tariffs and the collection of international trade statistics, such as the Harmonized Commodity Description and Coding System (HS), to better reflect WWT technologies.
- Facilitate multi-stakeholder platforms involving governments, industry, financial institutions, and NGOs to support and accelerate circular economy initiatives and capacity building for institutional and technical readiness through setting up a regional centre of excellence (RCoE) while ensuring transparency, replicability, and accountability.
- Leverage climate and green funds to support sectoral and regional replication of wastewater reuse and energy efficiency (e.g., in textiles), and support demonstration projects to validate locally adapted WWT technologies.
- Facilitate matchmaking and financing of successful collaborative models (e.g., South-South university-company partnerships), with a view to develop scalable business models that can be replicated across geographies.
- Facilitate multi-stakeholder-dialogue and the sharing of best practices in key areas (e.g., WWT technology development and knowledge transfer).
- Support trade facilitation reforms and measures as well as access to relevant customs infrastructure such as digital technologies that can further reduce customs-related impediments to import of WWT technologies.

22 In addition to pricing, fees for discharging water could also influence the incentive to reuse it.

References

Azanaw, A., Birlie, B., Teshome, B., & Jemberie, M. (2022). T*extile effluent treatment methods and eco-friendly resolution of textile wastewater*. Case Studies in Chemical and Environmental Engineering, 6, 100230.

Bangladesh Investment Development Authority (BIDA). (2024). *Bangladesh RMG industry – A global hub for garments manufacturing and sourcing*. Bangladesh Investment Development Authority (BIDA). Available at: https://www.bida.gov.bd/investment-sector/textiles-apparels/.

Bellmann, C., & Bulatnikova, A. (2022). *Incorporating environmental provisions in regional trade agreements in chapters and articles dealing with trade in services.* OECD Trade and Environment Working Papers 2022/01. Paris: OECD Publishing. Available at https://www.oecd.org/content/dam/oecd/en/publications/reports/2022/07/incorporating-environmental-provisions-in-regional-trade-agreements-in-chapters-and-articles-dealing-with-trade-in-services_88754d4b/6e976798-en.pdf/.

Botté, A., Zaidi, M., Guery, J. et al.. (2022). Aluminium in aquatic environments: abundance and ecotoxicological impacts. Aquatic Ecology, Vol. 56, pp. 751–773 (2022). https://doi.org/10.1007/s10452-021-09936-4.

Bucher, H., Drake-Brockman, J., Kasterine, A., & Sugathan, M. (2014). *Trade in Environmental Goods and Services: Opportunities and Challenges* (Technical Paper). Geneva: International Trade Centre. Available at: https://www.intracen.org/resources/publications/trade-in-environmental-goods-and-services-opportunities-and-challenges/.

Circle Economy. (2024). *The circularity gap report: Textile*. Circle Economy Foundation, News. Available at: https://www.circle-economy.com/news/just-0-3-of-materials-used-by-the-global-textile-industry-come-from-recycled-sources-with-almost-no-textile-to-textile-recycling.

Eccles, R. G., Ioannou, I., & Serafeim, G. (2014). *The impact of corporate sustainability on organizational processes and performance.* Management Science, 60(11), 2835–2857. Available at: http://www.jstor.org/stable/24550546.

European Parliament (2020). *The impact of textile production and waste on the environment (infographics)*. Available at: https://www.europarl.europa.eu/topics/en/article/20201208STO93327/the-impact-of-textile-production-and-waste-on-the-environment-infographics#:~:text=Textile%20production%20is%20estimated%20to,up%20in%20the%20food%20chain.

Feng, T., & Wang, D. (2016). The influence of environmental management systems on financial performance: A moderated-mediation analysis. Journal of Business Ethics, 135(2), 265–278. Available at: http://www.jstor.org/stable/24736081.

Fintech (2025, forthcoming). *Financial Advisory and Capacity Building*. Report prepared for the SMEP Programme in the framework of the "Scaling Resource Efficiency and Cleaner Production (RECP) in the Nairobi Rivers Basin" Project.

GlobalNewsWire (2025). *Water and wastewater treatment market size to worth US$ 652.30 bn by 2034 with a 6.5% CAGR*. GlobalNewsWire, 25 February 2025. Available at: https://www.globenewswire.com/news-release/2025/02/25/3031651/0/en/Water-and-Wastewater-Treatment-Market-Size-to-Worth-US$-652-30-Bn-by-2034-with-a-6-5-CAGR.html/.

Kenya National Cleaner Production Centre (KNCPC). (2025, forthcoming). *Industry mapping and pollution load determination.* Report prepared for the SMEP Programme in the framework of the "Scaling Resource Efficiency and Cleaner Production (RECP) in the Nairobi Rivers Basin" project.

Kuzma, S., Saccoccia, L., & Chertock, M. (2023). *25 countries, housing one-quarter of the population, face extremely high water stress*. World Resources Institute (WRI), 16 August 2023. Available at: https://www.wri.org/insights/highest-water-stressed-countries/.

Panda, S. K. B. C., Sen, K., & Mukhopadhyay, S. (2021). *Sustainable pretreatments in textile wet processing*. Journal of Cleaner Production, 329, 129725.

Stockholm International Water Institute (SIWI). (2020). *Water tariffing: What's at stake?* Available at: https://www.siwi.org/wp-content/uploads/2020/03/AEWPP_-Water-Tariffing-2020_WEBB.pdf.

Sauvage, J., & Timiliotis, C. (2017). *Trade in services related to the environment*. OECD Trade and Environment Working Papers, 2017/02. Paris: OECD Publishing. Available at: https://doi.org/10.1787/dc99bf2b-en.

Sustainable Manufacturing and Environmental Pollution (SMEP). (2024). *Project on enhancing uptake of resource efficiency & cleaner production in enterprises with piloting membrane technology and financial services for wastewater treatment in the Nairobi Rivers Basin: Policy dialogue workshop on industrial and institutional pollution prevention in the Nairobi Rivers Basin, Panari Hotel, Mombasa Road, Nairobi City County, 4 October 2024: Policy options for pollution reduction and enhanced compliance by industry and businesses in the Nairobi Rivers Basin.* Available at: https://unctad.org/system/files/information-document/policy-options-smep_policy-workshop_4.10.2024.pdf.

Tella, T. A., Festus, B., Olaoluwa, T. D., & Oladapo, A. S. (2025). Chapter 15 – Water and wastewater treatment in developed and developing countries: Present experience and future plans. In *Smart nanomaterials for environmental applications* (Micro and Nano Technologies, pp. 351–385). Elsevier. Available at: https://doi.org/10.1016/B978-0-443-21794-4.00030-2.

United Nations Department of Economic and Social Affairs (UN DESA). (n.d.). *Sustainable development: The 17 goals.* Available at: https://sdgs.un.org/goals/.

United Nations. (2017). *The United Nations world water development report 2017: Wastewater: An untapped resource*. Paris: UNESCO. Available at: https://www.unwater.org/publications/un-world-water-development-report-2017/.

United Nations. (2024). *The United Nations world water development report 2024: Water for prosperity and peace.* Paris: UNESCO. Available at: https://www.unesco.org/reports/wwdr/fr/2024/.

UN Trade and Development (UNCTAD). (2025a). *Liquid asset: Rethinking water use in global manufacturing powerhouses*. Available at: https://unctad.org/news/liquid-asset-rethinking-water-use-global-manufacturing-powerhouses/.

UNCTAD. (2025b). *Solutions in traditional knowledge: How gravity water filters could help reduce single-use plastics in sub-Saharan Africa*. Available at: https://unctad.org/publication/solutions-in-traditional-knowledge-gravity-water-filters/.

United Nations Environment Programme (UNEP). (2018). *Trade in environmentally sound technologies: Implications for developing countries.* Available at: https://www.unep.org/resources/report/trade-environmentally-sound-technologies-implications-developing-countries chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/.

UNEP. (2023). *Wastewater: Turning problem to solution*. Available at: https://www.unep.org/resources/report/wastewater-turning-problem-solution/.

United Nations Secretary-General. (2024). *Sustainable Development Goals progress report 2024: Advanced unedited version* (A/79/79-E/2024/54). United Nations Department of Economic and Social Affairs, Statistics Division. Available at: https://unstats.un.org/sdgs/files/report/2024/SG-SDG-Progress-Report-2024-advanced-unedited-version.pdf.

Vivas-Eugui, D., & Dewar, E. (2025). *Wastewater management & development* [Presentation]. United Nations Conference on Trade and Development (UNCTAD), 11 December 2025. Available at: https://unctad.org/system/files/non-official-document/ditc-ted-11122024-solids-unctad-1.pdf.

World Resources Institute (WRI). (n.d.). *Aqueduct: Using cutting-edge data to identify and evaluate water risks around the world.* Available at: https://www.wri.org/aqueduct/.

World Trade Organization (WTO). (2005). *Synthesis of submissions on environmental goods.* Committee on Trade and Environment Special Session, TN/TE/W/63, 17 November 2005. Available at: https://docs.wto.org/dol2fe/Pages/FE_Search/FE_S_S001.aspx.

Jyothi, N. R. (2020). *Heavy metal sources and their effects on human health*. In Heavy metals – Their environmental impacts and mitigation. IntechOpen.

Annex

Six-digit HS 2022 codes assigned to industrial WWT technologies and related product groups

Code	Description	Traded goods	Subgroup	Group
841350	Pumps; reciprocating positive displacement pumps, n.e.c. in heading no. 8413, for liquids.	Dosing pumps and stations for acid, caustic soda, antiscalants and/or other process chemicals.	Dosing pumps and stations	Parts and components
841370	Pumps; centrifugal, n.e.c. in heading no. 8413, for liquids.	Pumps for lifting, feeding, sludge recycling and extraction, ultrafiltration (UF), cleaning in place (CIP), reverse osmosis (RO) and other applications.	Process pumps	Parts and components
841391	Pumps; parts thereof.	Spare parts of process pumps.	Pumps PARTS	Parts and components
841440	Compressors; air compressors mounted on a wheeled chassis for towing.	Air compressors.	Compressors and blowers	Parts and components
841480	Pumps and compressors; for air, vacuum, or gas, n.e.c. in heading no. 8414.	Air blowers, e.g., for backwash and air supply.	Compressors and blowers	Parts and components
841490	Pumps and compressors; parts, of air or vacuum pumps, air or other gas compressors and fans, ventilating or recycling hoods incorporating a fan.	Spare parts of compressors and blowers	Compressors and blowers PARTS	Parts and components
841989	Machinery, plant and laboratory equipment; for treating materials by change of temperature, other than for making hot drinks or cooking or heating food.	Cooling towers	Water cooling equipment	Parts and components
842121	Machinery; for filtering or purifying water.	Systems for aeration, dissolved air floatation (DAF), electrocoagulation (EC), filtration (e.g., multimedia, trickling), advanced oxidation, chemical-physical treatment, sludge dewatering, ultrafiltration (UF), disinfection, nanofiltration, reverse osmosis (RO). Other systems such as biological reactors, clarifier scraping bridges, ozonators, sonicators.	Water treatment systems E.G., ANALYSIS, TREATMENT, CONTROL, SLUDGE MANAGEMENT	Integrated systems
842199	Machinery; parts for filtering or purifying liquids or gases	Coarse bubble air diffusers, fine bubble air diffusers, cartridge filters, membrane housing and parts, UF and RO membrane elements	Filtration and aeration equipment	Parts and components

Code	Description	Traded goods	Subgroup	Group
847982	Machines; for mixing, kneading, crushing, grinding, screening, sifting, homogenizing, emulsifying or stirring	Mixers	Mixers and agitators	Parts and components
853710	Boards, panels, consoles, desks and other bases; for electric control or the distribution of electricity, (other than switching apparatus of heading no. 8517), for a voltage not exceeding 1000 volts	Control panels	Control panels and boards	Parts and components
902610	Instruments and apparatus; for measuring or checking the flow or level of liquids	Flow meter level sensors, weir flow meters, venturi meters and orifice plates	Control instruments FLOW, LEVEL, PRESSURE	Parts and components
902620	Instruments and apparatus; for measuring or checking pressure	Pressure switches	Control instruments FLOW, LEVEL, PRESSURE	Parts and components
902730	Spectrometers, spectrophotometers and spectrographs; using optical radiations (UV, visible, IR).	Spectrophotometers	Analysis instruments PHYSICOCHEMICAL PROPERTIES	Parts and components
902789	Instruments and apparatus; for physical or chemical analysis, for measuring or checking viscosity, porosity, expansion, surface tension or quantities of heat, sound or light, exposure meters	pH meter, dissolved oxygen meter	Analysis instruments PHYSICOCHEMICAL PROPERTIES	Parts and components
902790	Microtomes and parts and accessories thereof	Conductivity meter	Analysis instruments PHYSICOCHEMICAL PROPERTIES	Parts and components

↑ *Source: UN Trade and Development based on inputs from SMEP grantees.*

Note: The list includes industrial WWT technologies used in diverse applications, sectors, and countries. It is not exhaustive, focusing exclusively on critical equipment that is typically imported. The traded goods and associated HS codes are as reported by surveyed companies based on their customs clearing processes.

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