BUSINESS CASE

Partial Water Recycling in the Textile Industry

Combining Validated Pilot Evidence with an Innovative Financing Mechanism

Bangladesh | SMEP Programme (FCDO & UNCTAD) | February 2026

$0.30/m³	vs $2.20	80%+	~1.08	$700M
Partial Recycle Operating Cost	Conventional Thermal ZLD Cost	Water Recovery Denim Washing	Full-Scale SEC kWh/m³ (Denim)	Annual Consumer Surcharge Potential

Executive Summary

The SMEP pilot[1] has demonstrated, with measured data from two operational textile facilities in Bangladesh, that partial water recycling is technically feasible, discharge-compliant, and commercially viable today. This business case combines those technical findings with an innovative financing mechanism developed by QStone Capital with the support of Solidaridad to present a complete investment and implementation proposition.

The core finding is simple and powerful: factories can recycle 70-80% of their ETP-treated wastewater at approximately $0.30/m³ - a 7x cost advantage over conventional thermal ZLD at $2.20/m³. This is not a future technology; it is a proven system deployed in Bangladesh, tested on real wastewater from denim washing and woven reactive dyeing segments, and validated against DoE and ZDHC compliance thresholds.

The financing gap that has historically blocked adoption is addressed through a two-part mechanism, with AWP Tokens as the primary instrument: digital certificates representing independently verified, blockchain-recorded avoided water pollution, each redeemable by fashion brands, consumers, or institutional investors to substantiate sustainability claims. A second instrument - a 1% consumer sustainability surcharge at point of sale - generates up to $700 million annually in Bangladesh alone and, crucially, channels those consumer payments directly into AWP token purchases and retirement, closing the loop between retail spending and factory investment.

The Investment Proposition

Partial recycling is technically proven. The pilot removes technology risk. The financial model - while not yet commercially deployed - offers a credible and potentially scalable mechanism to remove capital access risk. Together they form a proposition ready for Phase 1 pilot deployment.

[1]The UK Government funds this research and pilot activity through UK International Development; however, the views expressed do not necessarily reflect the UK Government's official policies. The grant has been provided through the Sustainable Manufacturing and Environmental Pollution Programme (SMEP). The SMEP programme is funded by the UK Government and implemented in partnership with UN Trade and Development (UNCTAD). The grant has been awarded from Feb 2024 to Feb 2026. More information visit: www.smepprogramme.org

1. The Problem: A Structural Financing and Technology Gap

Bangladesh's textile sector discharges approximately 200 million litres of wastewater per day. Freshwater scarcity is intensifying, discharge standards are tightening, and international buyers are applying growing pressure on supply chain sustainability credentials. Yet adoption of water recycling technology remains extremely low. Two structural barriers explain this:

Technology Barrier	Financial Barrier
Factories lack validated, locally demonstrated performance data for membrane recycling. Vendor claims are not anchored to segment-specific feed chemistry, reject management, or discharge compliance evidence. Without a local reference case, procurement decisions carry unacceptable technical risk. **Result: factories delay or abandon investment even when the environmental case is clear.**	ZLD and partial recycling systems require $1-3 million in upfront capital. Factories operate on thin margins with short-term contracts. Fashion brands resist long-term financial obligations. No standardised mechanism exists to channel consumer sustainability willingness-to-pay toward factory infrastructure. **Result: a structural mismatch between long-term infrastructure needs and short-term revenue certainty.**

2. Technical Foundation: What the Pilot Proved

The SMEP pilot operated a 3-module containerised membrane system on real ETP-treated wastewater across two Bangladesh textile facilities, generating the first locally validated, independently measured performance dataset for this technology in the Bangladesh context.

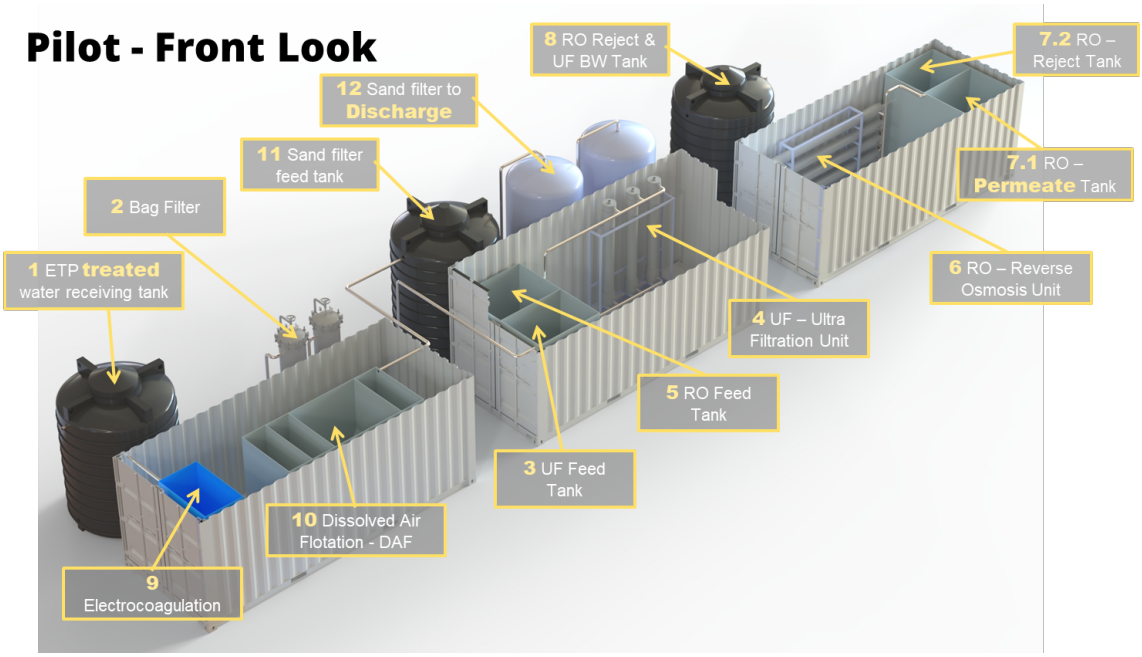

Figure 1. The SMEP pilot system - 3-container modular design tested at Bangladesh textile facilities

2.1 Validated Performance by Segment

The pilot confirmed that partial recycling performance varies by wastewater segment and must be engineered accordingly. Key results:

Parameter	Denim Washing	Reactive Dyeing	Business Implication
Water Recovery	80%+	60-70%	Denim is the strongest near-term commercial opportunity; reactive dyeing viable but requires more complex system design.
Permeate TDS	~100 mg/L	~100 mg/L	Recycle-quality water confirmed across both segments - suitable for direct return to production.
Reject Treatment	EC + DAF + Sand Filter	EC + DAF + Sand + Polishing Oxidation	Segment-specific reject design is non-negotiable; blanket system offers are inadequate.
Reuse Recovery	80%	67%	80% reuse means 80% reduction in freshwater intake for denim factories - a direct, measurable operating cost saving.

CAPEX (100 m³/h)	~$1.2M	~$2.0M	Investment sizes are within reach of mid-sized factories with appropriate financing structures.
OPEX (full scale)	~$0.18/m³	~$0.30/m³	Compelling vs. freshwater cost and vs. $1.80-2.20/m³ for conventional ZLD.
DoE Color Compliance	Yes (<120 Pt.Co)	Yes with polishing (<150 Pt.Co)	Both segments meet Bangladesh DoE 150 Pt.Co discharge limit within the validated treatment train.
Full-Scale SEC	~1.08 kWh/m³	~1.8-2.5 kWh/m³	Energy costs are manageable at full scale; pilot SEC figures (4-8 kWh/m³) overstate operating costs significantly.

2.2 Why Partial Recycling - Not Full ZLD - Is the Right Starting Point

Conventional thermal ZLD (multi-effect evaporation + ATFD crystallisation) is technically proven but economically non-viable at $2.20/m³ OPEX and $3.5M CAPEX for a reactive dyeing plant. Partial recycling at 70-80% recovery delivers the vast majority of the water saving at a fraction of the cost, while the remaining brine management challenge is addressed through the proposed next-phase multi-membrane purification route.

System Approach	CAPEX	OPEX	Water Recovered
Partial Recycle - Denim Washing (70%)	~$1.2M	~$0.18/m³	70%+ of ETP flow
Partial Recycle - Reactive Dyeing (70%)	~$2.0M	~$0.30/m³	70%+ of ETP flow
Partial Recycle - Sweater Washing (70%)	~$0.9M	~$0.12/m³	70%+ of ETP flow
Conventional ZLD - Denim Washing	~$2.0M	**~$1.80/m³**	~95%+ (full discharge elimination)
Conventional ZLD - Reactive Dyeing	~$3.5M	**~$2.20/m³**	~95%+ (full discharge elimination)

Note: All CAPEX/OPEX figures are indicative estimates for a 100 m³/h plant. Actual values depend on site conditions, supplier selection, and local energy tariffs.

Figure 2. The SMEP pilot containers deployed on site in Bangladesh - funded by SMEP

3. The Financing Mechanism: Closing the Capital Gap

Technical feasibility alone is insufficient to drive adoption. The financial gap - factory inability to mobilise $1-3M in upfront capital against uncertain revenue - is the critical remaining barrier. The proposed financial model, developed by QStone Capital with the support of Solidaridad, addresses this through two interlocking instruments that are promising in design but have not yet been deployed or commercially tested.

The model's core innovation is converting traditional equipment financing into result-based financing: instead of a factory borrowing to buy a treatment system, a financier provides a loan and receives AWP tokens as annuity-like repayment. Those tokens are then offered on an exchange where brands, consumers, and investors buy and retire them to substantiate sustainability claims. This structure means water treatment generates revenue rather than being a financial drain.

> **Important Note on the Financial Model**
>
> The AWP Token system and ESG Fund structure described in this section have not yet been deployed or commercially tested. They represent a well-designed and potentially deployable financing framework, developed with validated cost data from the SMEP pilot as their economic foundation. The recommended next step is a structured Phase 1 pilot to test the financial model in parallel with the first commercial recycling plant deployments.

3.1 Module 1: AWP Token System - The Primary Instrument

The AWP (Avoided Water Pollution) Token is the structural innovation at the heart of the model. Each token represents a defined, independently verified volume of water recycled and not discharged - making environmental impact into a tamper-proof, tradeable, auditable financial asset. A token carries a digital switch that, when activated by the holder, permanently inhibits any further transfer - this 'retirement' is the act that entitles the holder to claim the avoided water pollution.

01	**Data Collection**	IoT sensors installed at every step of the treatment system, with positioning, cross-checks, and sensor independence approved by an independent auditor. Monitors water treatment volumes and brine/sludge processing in real time.
02	**Independent Verification**	Independent auditing and automated validation of sensor data. A third-party certification body (e.g. SGS-type entity) certifies IoT setup and confirms treatment volumes.

03	**Token Issuance**	Blockchain protocol generates 1 AWP token per defined volume of water recycled (e.g. 100 m³). Tokens are tamper-proof, transparent, and automated.
04	**Token Monetisation**	Tokens priced at the independently established cost benchmark per m³ of efficient ZLD treatment. Offered on a controlled exchange (DeX) for purchase and retirement by fashion brands, consumers, or institutional investors.
05	**Token Retirement**	Buyer activates the digital switch, permanently retiring the token. This irrevocable act is the sole basis for a sustainability claim - preventing double-counting and greenwashing.

3.2 Module 2: Consumer Sustainability Surcharge (1%)

A 1% surcharge applied at point of sale on garments in export markets (principally EU consumers) provides a second, complementary funding stream. Crucially, the surcharge is most powerful when its proceeds are used to purchase and simultaneously retire AWP tokens - meaning each consumer payment directly substantiates a verified, quantified sustainability claim rather than flowing into a general fund.

A per-garment wastewater standard will be established based on industry norms (for example, 70 litres per pair of jeans), allowing each purchase to be linked to a precise volume of water recycled. Research by QStone Capital and Solidaridad Europe indicates consumers are willing to pay up to 3% on top of their usual purchase price, on the condition that the surcharge is demonstrably traceable to the factory. Estimated potential for Bangladesh: up to $700 million annually, based on ~$45 billion export value translating to ~$100 billion retail value, with 30% remaining unsold.

What it does	Strategic advantage	Limitation
• Provides steady, consumer-driven funding flow • Proceeds used to purchase and retire AWP tokens - creating verified sustainability claims • Links each garment purchase to a defined	• Consumer willingness up to 3% if traceable to source • Does not require brand long-term commitment • Scales directly with garment sales volume	• Dependent on fashion brand participation for implementation • Fragmented supply chains (factories serve multiple brands) create partial funding allocation • Creates a 'glass ceiling' without the AWP Token mechanism as

volume of water recycled		the primary instrument

3.3 Institutional Structure

The model operates through a modular ecosystem of five institutional actors, reducing dependency risk and enabling scalability without requiring a single dominant institution. The central financial mechanic is a loan-to-token structure: a financier provides a loan to the factory, receives AWP tokens as annuity-like repayment, and then sells or retires those tokens via a controlled exchange.

Institution	Role	Connection to Pilot
Anchor Investor / ESG Fund	Provides the initial loan to finance the recycling installation. Receives AWP tokens as annuity-like repayment. Offers tokens on the DeX exchange for sale or retirement. In Phase 1 this may be a single anchor investor; in later phases a formal ESG Textile Impact Fund. Capital sources: impact investors, family offices, ESG asset managers, development finance.	Token pricing will be determined based on a combination of treatment cost benchmarks, market demand and investor return requirements and will be validated during Phase 1 deployment.
Independent Verification Body	Third-party certification of IoT sensor setup (including positioning and independence), treatment volumes, and AWP token integrity (e.g. SGS-type entity). Essential for token credibility.	Pilot's third-party test results and ZDHC compliance data establish the measurement framework for token certification.
Technology & Tokenisation Platform	Cloud-based blockchain infrastructure issuing AWP tokens, connected to on-site IoT sensors. Ensures immutability, transparency, and smart contract-based payment automation. QStone is currently seeking co-funding to develop this platform.	Pilot IoT data infrastructure provides the template for sensor integration and token issuance protocols.
Treasury / DeX (Liquidity Pool)	Controlled exchange matching AWP token supply (from loan-providing financiers) with buyers wishing to purchase and retire tokens. Initially permissioned with a floor value - not a public DeFi market. Stabilises token pricing.	Token pricing will be determined based on a combination of treatment cost benchmarks, market demand, and investor return requirements, and will be validated during Phase 1 deployment.
NGOs / Industry Bodies	Solidaridad Network Asia, BGMEA, BKMEA. Build factory trust, support onboarding, ensure social and	Solidaridad's SMEP programme leadership and existing factory relationships

	environmental integrity. Not required for financial execution but critical for adoption velocity.	are the primary onboarding channel.

4. Value Proposition by Stakeholder

The business case is compelling across all stakeholder groups. Critically, no single actor bears the full cost, and each receives proportionate value:

Stakeholder	Value Received	What They Give
Textile Factories	Full upfront financing for recycling installation. Immediate reduction in freshwater purchase costs. Long-term revenue certainty via AWP token stream. Compliance with DoE and ZDHC standards. Strengthened buyer relationships.	Commitment to IoT monitoring and token issuance. Operational discipline in system management. Transparency on treatment volumes.
ESG Investors / Fund	Predictable, annuity-like returns backed by real garment sales and verified environmental outcomes. New asset class (tokenized environmental impact). Measurable, auditable ESG portfolio impact.	Upfront capital for installation financing. Token purchase at floor price. Participation in fund governance.
Fashion Brands	Credible, auditable Scope 3 sustainability claims. Reduced greenwashing risk. No long-term contractual lock-in. Alignment with EU due diligence and supply chain sustainability regulations.	Optional: channel 1% surcharge. Purchase AWP tokens for ESG reporting. Preference in sourcing for participating factories.
Consumers (EU / Global)	Direct, verified contribution to reducing textile water pollution. Transparent impact per purchase. Low financial burden (1% of garment price).	1% surcharge at point of sale - voluntary but structured.
Bangladesh Government	No fiscal burden. Measurable improvement in discharge quality and freshwater conservation. Progress toward environmental compliance targets without direct intervention.	Regulatory recognition of AWP tokens. Supportive import duty framework for recycling equipment.

Programme Sponsors (FCDO / SMEP)	Validated scale-up pathway from pilot investment. Replicable model for other geographies and manufacturing sectors. Demonstrable development impact from grant expenditure.	Technical credibility and local ecosystem relationships from SMEP programme.

5. Financial Flow Architecture

The model creates a closed-loop capital flow connecting consumer spending to factory investment through verified environmental impact. The flow operates across four linked channels:

01	**Financier to Factory (Loan)**	Anchor investor or ESG fund provides an upfront loan to finance the partial recycling installation. The factory does not bear the capital burden; the financier takes on the investment risk in exchange for token-based repayment.
02	**Factory to Financier (Tokens)**	As the treatment system operates, IoT sensors and the blockchain platform generate AWP tokens based on verified volumes of water recycled. These tokens flow to the financier as annuity-like loan repayment - water treatment generates revenue instead of being a cost.
03	**Financier to Exchange (DeX)**	The financier offers AWP tokens on the controlled exchange for purchase and retirement. Buyers include fashion brands (for Scope 3 ESG claims), consumers (via the 1% surcharge pool which buys and retires tokens automatically), and institutional investors.
04	**Buyer Retires Token**	Each buyer activates the digital retirement switch on purchased tokens, permanently inhibiting transferability. This irrevocable act is the sole basis for a sustainability claim - ensuring no double-counting and full traceability from factory treatment to claimant.

The Loan-to-Token Mechanic

A financier provides a loan to install the recycling system. The factory repays via AWP tokens generated by its treatment operations. The financier then offers these tokens on the DeX exchange. Fashion brands, consumers (via the 1% surcharge pool), or institutional investors purchase and retire the tokens to substantiate their sustainability claims. Token pricing will be determined based on a combination of treatment cost benchmarks, market demand, and investor return requirements, and will be validated during Phase 1 deployment.

6. Implementation Roadmap

The proposed roadmap integrates both the technical scale-up from the SMEP pilot and the financial model deployment across four phases:

Phase	Timeline	Technical Actions	Financial Actions
Phase 1 Pilot	0-10 months	Deploy 2-3 commercial partial recycling plants based on SMEP pilot design. Prioritise denim washing segment. Commission segment-specific performance monitoring with IoT sensor infrastructure.	Identify and secure an Anchor Investor willing to provide an initial loan and accept AWP tokens as repayment. Deploy IoT and tokenisation platform (cloud software development). Establish independent verification body partnership. Define token pricing accordingly.
Phase 2 Fund Structuring	10-18 months	Expand to reactive dyeing segment. Validate reject polishing oxidation at commercial scale. Begin brine management pilot (non-evaporative multi-membrane route).	Define investor return structure and token pricing model formally. Engage a fashion brand as 'launching customer' - first buyer to purchase and retire AWP tokens for ESG reporting. Explore formalising anchor investor into a structured ESG Textile Impact Fund.
Phase 3 Scaling Liquidity	18-24 months	Scale to 10+ factories across denim and reactive dyeing segments. Standardise system design packages by segment. Build local O&M service ecosystem.	Attract additional financiers willing to provide loans with AWP token repayment. Introduce secondary AWP token market (DeX) with price discovery. Scale institutional and brand token buyers. Explore replication in other geographies.
Phase 4 Consumer Integration	24-36 months and 0-36+ months	Full commercial ecosystem operating. Brine management next phase deployed. Local membrane servicing capability established.	Introduce 1% consumer surcharge via retail channels in EU. Configure surcharge proceeds to automatically purchase and retire AWP tokens - each consumer payment substantiates a per-garment water recycling claim based on agreed industry standards (e.g. 70L per pair of jeans).

7. Risks and Mitigations

The business case carries risks that must be actively managed. The following are the primary risks, their root causes, and the mitigating factors already in place or proposed:

Risk	Severity	Description	Mitigation
Technology Performance	**Low**	Pilot SEC and recovery figures have been measured and validated. Segment-specific design is well-understood. Risk of underperformance is low if design follows pilot evidence.	Mandate pilot-based performance envelopes for all procurement. Require feed characterisation before system specification.
Brand Adoption Resistance	**Medium**	Fashion brands may resist 1% surcharge implementation or token purchasing due to operational changes and sourcing flexibility preferences.	The financial model does not require brand participation in Phase 1. Brands are 'optional but beneficial'. Fund can operate independently of brand engagement initially.
Financial Model Not Yet Deployed	**Medium-High**	The AWP token system and ESG fund structure have not been commercially tested. Token pricing, investor return structure, and market appetite remain to be validated through actual deployment.	Phase 1 is designed as a concurrent pilot of both the technical system and the financial model. Seed fund scale is kept small. Financial assumptions are anchored to validated pilot cost data from the SMEP programme.
Regulatory / Token Classification	**Medium**	AWP tokens may face regulatory questions on classification across multiple jurisdictions. A specific unresolved question is whether the treatment installation is provided under a lease arrangement or whether ownership and token rights transfer to the financier. This affects the legal structuring of the loan-to-token repayment mechanism.	Initial operation as a permissioned system (not public DeFi) reduces regulatory exposure. Engage Bangladesh Bank, SEC, and EU regulators early. Clarify ownership and lease structure before Phase 1 financial close.

IoT / Blockchain Integration	**Medium**	Reliable IoT monitoring across variable factory conditions and blockchain infrastructure maintenance are technically complex.	Phase 1 verification body engagement and phased technology deployment allows iterative de-risking before scale-up.
Import Duties	**Medium**	High import duties on membrane equipment increase CAPEX and erode financial model returns.	Engage Bangladesh government for duty exemption for verified recycling equipment. SMEP / FCDO advocacy role.
Market Education	**Low-Medium**	Consumer and stakeholder understanding of AWP tokens and surcharge purpose may be limited initially.	Solidaridad's communication infrastructure and SMEP programme credibility provide the education platform.

8. Conclusion: A Deployment-Ready Business Case

This business case presents a complete, evidence-based proposition for scaling partial water recycling in Bangladesh's textile sector. It is built on two mutually reinforcing foundations: a technically validated pilot that eliminates technology risk, and an innovative financing model that eliminates capital access risk.

The SMEP pilot has done what pilot programmes are designed to do: it has generated locally measured, independently verified performance data that transforms partial recycling from a vendor promise into an engineered, deployable solution. Factories now have a local reference case they can inspect, a validated cost benchmark they can build a business case around, and a treatment design they can specify without guesswork

The AWP Token and ESG Fund model does what no previous Bangladesh textile sustainability initiative has achieved: it creates a direct financial bridge between consumer spending and factory investment, without requiring government subsidy, brand charity, or factory risk-tolerance beyond what the verified performance data justifies.

The pilot gives the financial model a credible economic foundation - real, audited cost data that anchors the AWP token floor price and fund return structure. The financial model gives the pilot a commercial scale-up pathway. Together they present a proposition that is technically de-risked and, with Phase 1 deployment of the financial mechanism, potentially ready for broad commercial rollout.

Immediate Next Steps

Three concrete actions have been identified by QStone Capital to initiate deployment of the financial model alongside the first commercial recycling plants:

01	Co-funding for platform development. QStone is seeking a co-funding partner to support the continuing development - alongside QStone's own in-kind contribution - of the cloud-based software connecting the IoT sensor system embedded in the water treatment installation with the AWP token issuance platform. This is the foundational technical prerequisite for the entire financial mechanism.
02	Anchor Investor as initial market maker. Once the platform is operational, an anchor or seed investor is needed to provide the first loan and purchase the AWP tokens generated by the first 1-3 factories. This first-mover establishes the token floor price, proves the repayment mechanic, and creates the reference transaction for subsequent investors.
03	Fashion brand as launching customer. A fashion brand willing to be the first buyer of AWP tokens via the DeX - purchasing and retiring them for credible, auditable ESG claims - provides the demand-side anchor that completes the ecosystem and validates the commercial token market.

The case for action

Partial water recycling in Bangladesh's textile sector is technically proven and commercially viable. The financing model is designed, grounded in real cost data, and potentially deployable.

At $0.30/m³ versus $2.20/m³ for thermal ZLD, with verified DoE compliance and a credible financing ecosystem ready for its own pilot phase, the barriers to scale-up are now addressable.