

A Data-Driven Circular Economy Roadmap for HDPE Plastics in Ghana (2025-2028)



Authors

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| Executive Summary

Ghana produces over **1.1 million** tonnes of plastic waste each year, of which more than **70%** is not formally collected or processed. The national Circular Economy Opportunity Mapping study confirmed that most of this plastic, particularly HDPE (High-Density Polyethylene), is technically recyclable but is largely lost through systemic inefficiencies. Used extensively for jerrycans, detergent bottles, crates, buckets, and shampoo containers, HDPE represents approximately **18–20%** of all plastic packaging consumed. Yet less than 1 in 4 HDPE items is ever recovered, with most ending up in open dumps, drainage systems, or burnt in informal sites.

The HDPE-specific roadmap presented here responds directly to this problem. Drawing from detailed material flow analysis, life cycle assessment data, and stakeholder consultation, it provides a focused strategy to reduce losses, support inclusive livelihoods, and scale viable circular business models. HDPE was selected for this in-depth intervention due to its combination of high volume, high value, and underutilised recovery potential. Its physical properties, durability, chemical resistance, and recyclability make it ideal for reuse and reprocessing. However, in the

absence of standardised sorting, traceable flows, and certified recycle markets, these advantages are not being captured at scale.

Baseline assessments show that less than **2%** of local products currently incorporate recycled HDPE (rHDPE). Most recycled HDPE flakes are of inconsistent quality, often contaminated or mixed with other polymers, which limits reintegration into formal manufacturing. Leakage is particularly pronounced in the post-consumer phase, especially for smaller-format containers used in domestic and institutional settings. Ghana's recycling infrastructure remains concentrated in a few urban centres, leaving peri-urban and secondary towns with limited access to recovery facilities.

This roadmap defines five high-impact interventions, three directly piloted and two proposed, to address key bottlenecks along the HDPE value chain. These pilots include decentralised HDPE aggregation hubs in Ashaiman and Kumasi, a manufacturer-led design-for-circularity partnership, and the development of certified rHDPE flake value chains. The proposed pilots focus on household collection incentives and public institution container recovery systems. Together, these are expected to divert over

1,000 tonnes of HDPE annually, equivalent to removing 3 Olympic swimming pools' worth of plastic from the environment each year.

The roadmap also lays the foundation for scaling inclusive circular business models. With stable off-take agreements, digital traceability, and modular CE training, income levels for informal waste workers involved in HDPE collection are expected to increase by up to **50%** over baseline. At least **60%** of beneficiaries across pilots and enterprise support schemes will be women or youth, particularly from low-income neighbourhoods and informal settlements. This reflects a commitment not only to material recovery but to equitable value distribution and skills development.

Monitoring and evaluation are built into every component. Environmental indicators include tonnes of HDPE diverted, GHG savings from avoided virgin resin, and rHDPE content in new products. Economic metrics will track cost-efficiency per tonne collected and investment leveraged through private and public channels. Social indicators include gender participation, training uptake, and community behavioural shifts. These are drawn from the broader Plastics Waste to Wealth M&E framework and adapted for relevance to HDPE.

Key focus areas include:

Reducing HDPE leakage by **50%** in hotspot districts by 2027.

Increasing rHDPE content in new products from under **2%** to at least 15%.

Expanding HDPE aggregation hubs from one (Accra) to four operational centres nationwide.

Formalising the involvement of at least **500** waste pickers and community collectors, supported with mobile tracking tools and training.

This roadmap is fully aligned with national CE policy goals, SDG targets, and just transition principles. It serves as both a practical tool for action and a reference point for coordination across stakeholders. By improving HDPE recovery systems, strengthening end-markets, and embedding circularity into product design and local enterprise, Ghana can unlock the full potential of HDPE as a driver of clean growth and inclusive industrialisation.



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1. Background

1.1. Vision

By 2028, Ghana will establish a resilient, inclusive, and regenerative circular economy for High-Density Polyethylene (HDPE), where all HDPE packaging and utility products, ranging from water sachets and carrier bags to jerrycans and detergent bottles, are either reused or recycled. Virgin HDPE inputs will be significantly reduced, and circular flows of both film and rigid HDPE will be scaled through improved infrastructure, enhanced collection, and active participation by both the formal and informal sectors. This transition will mitigate pollution and urban flooding, unlock local employment, and support sustainable material sovereignty.

1.2. Strategic Goals

1.2.1. Goal 1: Increase HDPE Collection Rate to 75% by 2027

Justification: At present, only about 1 in 2 units of HDPE waste is collected. This leaves vast volumes, equivalent to over 10,000 Olympic swimming pools annually, mismanaged or leaking into the environment. Raising collection to 3 out of every 4 units will require targeted interventions in urban hotspots like markets and drains, backed by better infrastructure and community engagement.

1.2.2. Goal 2: Raise HDPE Recycling Rate to 25% by 2027

Justification: Of the total plastic waste stream, HDPE is one of the most abundant, yet only ~10% is currently recycled. This means for every 10 containers used, 9 are either landfilled or leak into the environment. By tripling the current recycling rate, Ghana can substitute imported virgin resin and reduce lifecycle GHGs and energy use.

1.2.3. Goal 3: Ensure Recycled Content in at Least 15% of New HDPE Products by 2027

Justification: Today, fewer than 1 in 50 HDPE products on the market contains any recycled content. Setting a recycled-content target of 15%, roughly 1 part in 6, will stimulate demand for local recyclate, support investor confidence in recycling, and align with global EPR benchmarks.

1.2.4. Goal 4: Integrate and Formalise 10 Informal Waste Picker Cooperatives Nationwide by 2027

Justification: Informal workers recover up to 70% of recyclable plastics, yet remain marginalised. Formalising 10 cooperatives will not only strengthen their safety and livelihoods but ensure that Ghana's circular economy is inclusive and just. It will also help unlock financing and improve traceability in the recycling chain.



1.3. Alignment with Policy and Global Frameworks

1.3.1. National Development Plans:

The roadmap aligns with Ghana’s Coordinated Programme of Economic and Social Development Policies and the Medium-Term National Development Policy Framework, particularly under environmental sustainability, job creation, and local industrialisation targets.

1.3.2. Relevant Sectoral Policies:

National Plastic Management Policy
 Extended Producer Responsibility (EPR) Framework (in progress)
 Local Government Sanitation By-laws
 Sanitation and Pollution Levy Act (Act 1064, 2021)

1.3.3. Sustainable Development Goals (SDGs):



- a. **SDG 6** - Clean Water and Sanitation (reduce plastic pollution in waterways)
- b. **SDG 8** - Decent Work and Economic Growth (formalise waste sector jobs)
- c. **SDG 11** - Sustainable Cities and Communities (address urban flooding and waste)
- d. **SDG 12** - Responsible Consumption and Production (scale reuse and recycling)
- e. **SDG 13** - Climate Action (reduce lifecycle emissions through circularity)

1.3.4. Just Transition Principles:

- a. Integration of informal sector labour into legal frameworks and decision-making.
- b. Gender-sensitive and youth-inclusive capacity building.
- c. Equitable access to training, tools, and value creation in circular business models.

Table 1. Vision and Strategic Intent for HDPE Circular Economy Roadmap

Component	Description
Vision	Regenerative HDPE economy by 2028 with reuse/recycling as default, virgin inputs reduced, and leakage curtailed
Goal 1	HDPE Collection Rate \geq 75% by 2027
Goal 2	HDPE Recycling Rate \geq 25% by 2027
Goal 3	\geq 15% recycled-HDPE content in new HDPE products
Goal 4	\geq 10 formalised HDPE waste-picker cooperatives established nationally by 2027
Policy Alignment	National Plastic Management Policy, Sanitation and Pollution Levy Act, EPR Framework
SDG Alignment	SDGs 6, 8, 11, 12, 13, 14, 15
Just Transition	Formalisation, inclusion of women/youth, safe and decent work for informal sector actors

2. Baseline and Opportunity Mapping

2.1. Material Flow and Loss Patterns (MFA Insights)

- a. High-Density Polyethylene (HDPE) accounts for approximately 1 in every 6 tonnes of plastic imported into Ghana. Annually, over 220,000 tonnes of HDPE resin are imported into the country, with the majority used in single-use applications, including sachet water packaging, detergent and shampoo bottles, jerrycans, crates, and pipes (Ghana National Plastics Manufacturers Association, 2025). According to the NPAP Ghana Action Roadmap (2020), Ghana imported over 530,000 tonnes of rigid mono-material plastics in total, of which HDPE constitutes a substantial share, second only to PET. It is also estimated that annual HDPE leakage is estimated at 150,000 tonnes (2024), primarily post-consumer sachets and bottles. Among these, the most visible and ubiquitous item is the 500 ml sachet water bag, which alone accounts for an estimated 9,000-10,000 tonnes

Inflow (Imports):

Resin imports via Tema and Takoradi ports, entering industrial production zones.

b. Production and Use:

HDPE is converted into rigid containers (buckets, bottles), film for sachet water, and structural utilities (pipes, crates).

c. Post-Use Collection:

Collection coverage remains uneven, with less than 50% of HDPE waste formally collected—mostly concentrated in urban centers like Accra and Kumasi. In rural and peri-urban areas, sachets and containers are discarded in open drains, fields, or burned in backyards.

d. Recycling:

Of the collected fraction, only about 1 in 5 items is eventually reprocessed. This leads to an effective national HDPE recycling rate of approximately 10%.

e. Leakage Points:

per year, or over 500 million sachets each month. Current rHDPE yield from collected HDPE is approximately 10–12%, due to contamination and downcycling.


The material flow of HDPE follows this simplified structure:

- **Sachet water bags** clog stormwater drains, contributing to urban flooding.
- **Detergent bottles and containers are** often contaminated or co-disposed with organic waste.
- **HDPE rigid packaging** is commonly downcycled into low-value goods like broom handles or not collected at all.


Cumulatively, this results in over **15,000 tonnes of HDPE lost annually**, roughly the volume of **10,000 refuse collection trucks**.

2.2. Life Cycle Emissions and Environmental Burdens (LCA Insights)

The life cycle of High-Density Polyethylene (HDPE), from resin import through production, consumption, and end-of-life disposal, poses a range of environmental burdens, particularly within Ghana’s waste management context. Table 2 provides a summary of life cycle assessment (LCA) estimates, highlighting energy consumption, greenhouse gas (GHG) emissions, water use, and toxicity risks at each stage. Notably, resin import and local packaging manufacturing contribute significantly to emissions, with energy demands exceeding 1,000 kWh per tonne and GHG emissions ranging between 1,250–1,700 kg CO₂e per tonne. Post-consumer practices such as open burning remain critical hotspots, generating between 2,000–2,500 kg CO₂e per tonne and releasing harmful dioxins and particulates, among the highest across common plastic types. These findings underscore the urgency of transitioning to controlled recovery pathways and enhancing recycling capacity to mitigate toxicity and carbon intensity across the HDPE value chain.



Notably, resin import and local packaging manufacturing contribute significantly to emissions, with energy demands exceeding **1,000 kWh** per tonne and GHG emissions ranging between **1,250–1,700 kg CO₂e** per tonne.



Post-consumer practices such as open burning remain critical hotspots, generating between **2,000–2,500 kg CO₂e** per tonne and releasing harmful dioxins and particulates, among the highest across common plastic types.

Table 2. Life Cycle of Emissions and Environmental Burdens of HDPE

Stage	Energy Use (kWh/tonne)	GHG Emissions (kg CO ₂ e/tonne)	Water Use (L/tonne)	Notable Toxicity Concerns
Resin Import & Processing	1,400	1,700	500	Airborne emissions during port unloading
Manufacturing (Packaging)	1,100	1,250	300	Additives used in film extrusion
Post-Consumer Collection	300	400	200	Open burning in informal recovery
Recycling (if any)	900	850	700	Dyes, detergents in wash water
Open Dumping/ Burning	-	2,000-2,500	-	Dioxins and particulates

Of all plastic types, HDPE generates one of the highest particulate emissions when burned, especially when films are burned in open spaces, a common practice across Ghana.

2.3. Social Baseline and Inclusion Gaps

The HDPE value chain in Ghana is marked by informal dominance at the post-use stage and gendered labour dynamics:

A Informal Recovery Workers: Predominantly women and youth (ages 16-35), especially in sachet water collection. These actors often operate in poor conditions, without personal protective equipment or access to stable buyers.	B Processing and Aggregation: Small-scale extruder operations are largely male-owned, with limited employment security for workers. Fewer than 1 in 10 processing enterprises employ women in technical roles.
C Education and Skills: Most collectors and sorters have not completed secondary school. Limited training opportunities exist, particularly in quality assurance, health and safety, or entrepreneurship.	D Cooperative Membership: Less than 5% of waste pickers engaged in HDPE recovery are part of any formal cooperative or union, leading to fragmented voice and poor negotiation power.

2.4. Current Circular Practices and Systemic Gaps

Despite growing awareness of plastic waste challenges, circular practices specific to HDPE remain underdeveloped and fragmented across Ghana. As shown in Table 3, sachet water pouch collection is largely informal and economically unviable due to the low weight-to-volume ratio of the material. Recovery of rigid HDPE items such as jerrycans is beginning to emerge, particularly in urban areas, though aggregators often face constraints related to undercapitalization and equipment deficits. Downstream processes like washing and flake production are limited in scale, with few recyclers operating HDPE-specific washing lines and little oversight on water use. Moreover, the use of recycled HDPE (rHDPE) in manufacturing is rare, hindered by the absence of quality certification standards and buyer confidence. Finally, the complete absence of government- or EPR-supported take-back systems points to a critical systemic gap in promoting material return and reuse. These findings emphasize the need for targeted investment, policy frameworks, and market incentives to activate a functioning circular HDPE economy.

Table 3. Current Circular Practices and Systemic Gaps

Practice	Status	Observations
Sachet water collection	Partial	Driven by informal actors; low volume per kg makes collection financially unattractive.
Rigid HDPE recovery (e.g., jerrycans)	Emerging	Aggregators exist in urban centres, but are undercapitalised and lack machinery.
Washing and flake production	Limited	Only a few urban recyclers operate HDPE washers; water use is unregulated.
Recycled-content product manufacturing	Rare	Recyclers cite buyer resistance and lack of quality standards for rHDPE.
Government or EPR-backed take-back	Absent	No major schemes exist to return HDPE containers or film for reuse/recycling.

2.5. Circular Hotspots Identified

A targeted assessment of Ghana’s HDPE value chain reveals five critical circular economy “hotspots” where systemic leakage, design inefficiencies, and infrastructural gaps persist. These hotspots represent pressure points that, if addressed, can significantly improve material recovery and reduce environmental burdens. For example, the widespread leakage of sachet films into drains underscores the urgency for localized collection solutions, while the continued use of coloured HDPE reduces the recyclability and value of recovered plastics. Other hotspots include the lack of recycled-content standards that stifle downstream innovation, informal sector practices that pose health risks, and full dependence on imported virgin resin. **Table 4** outlines each hotspot and proposes actionable circular economy opportunities that align with Ghana’s environmental and economic priorities.

Table 4. Circular Hotspots

Hotspot	Description	Opportunity
Sachet Film Leakage	Massive volumes of thin HDPE film clogging drains and causing flash floods	Decentralised sachet drop-off centres linked to informal aggregators
Low Recyclability of Coloured HDPE	Pigmented bottles and rigid containers limit reuse	Promote colour-free design standards and support label removal innovation
Lack of Standards for rHDPE	Absence of product specifications limits end-market uptake	Develop and enforce standards for minimum recycled content in rigid HDPE
Informal Processing Risks	High health and environmental risks due to burning and unsafe operations	Formalise actors through cooperatives and safety training
Virgin Resin Dependence	No domestic resin production, fully import-dependent	Incentivise resin substitution with domestic recycle

As shown in **Table 5**, targeted opportunities exist to stimulate demand for recycled

Table 5. HDPE Baseline and Opportunity Mapping

Indicator	Current Status (2024)	Issue Highlighted	Circular Opportunity
Annual Resin Imports	~22,000 tonnes	Full dependence on imports	Develop rHDPE market
Collection Rate	~50%	Uneven, driven by informal sector	Support aggregation hubs and logistics
Recycling Rate	~10%	Most waste lost or downcycled	Improve sorting, standards, and offtake
Recycled Content in Products	<2%	No buyer incentives or mandates	Introduce recycled content policy targets
Informal Sector Inclusion	High involvement, low support	Poor working conditions and voice	Formalise cooperatives and offer training

Greater Accra Region: This region produces the highest concentration of HDPE waste in the country. The informal sector is especially active, with 3,000-5,000 waste pickers in Accra alone recovering an estimated 60-70% of recyclables. Markets, households, and commercial centres here are major sources of HDPE waste.

Ashanti Region (Kumasi): A commercial and transport hub with significant plastic use in both rigid (e.g., containers) and flexible forms (e.g. sachets). Kumasi is a key node for scaling up material recovery facilities (MRFs) and sorting hubs.

Central and Western Regions: These coastal regions experience severe plastic pollution in waterways and beaches, making them critical for hotspot leakage mitigation efforts and community-based collection schemes.



3. Prioritisation and Scope Definition

3.1. Geographic Scope

The HDPE roadmap targets key urban and peri-urban centres in Ghana where HDPE generation, leakage, and informal sector engagement are most concentrated. Initial priority areas include:

The selection is driven by volume of HDPE waste, prevalence of mismanagement (notably in drains and dumpsites), and presence of informal sector actors already engaging in

a. Greater Accra Region: This region produces the highest concentration of HDPE waste in the country. The informal sector is especially active, with 3,000-5,000 waste pickers in Accra alone recovering an estimated 60-70% of recyclables. Markets, households, and commercial centres here are major sources of HDPE waste.

b. Ashanti Region (Kumasi): A commercial and transport hub with significant plastic use in both rigid (e.g., containers) and flexible forms (e.g. sachets). Kumasi is a key node for scaling up material recovery facilities (MRFs) and sorting hubs.

c. Central and Western Regions: These coastal regions experience severe plastic pollution in waterways and beaches, making them critical for hotspot leakage mitigation efforts and community-based collection schemes.

3.2. Value Chain Focus

This roadmap focuses on both HDPE film and HDPE rigid categories, reflecting their distinct roles and challenges within the Ghanaian plastics ecosystem.

- a. HDPE Film:** Primarily water sachets and carrier bags. These are low-value, thin, and often contaminated, making them difficult to recycle. They constitute a significant share of uncollected plastic waste and are frequently observed clogging drains, causing flooding during rainy seasons.
- b. HDPE Rigid:** Includes items like jerrycans, detergent bottles, drums, and piping. These items are more readily reused or recycled and often have informal market value. However, many still end up in open dumping due to lack of targeted collection infrastructure.

3.3. Prioritised Opportunities

Based on the baseline assessments and stakeholder consultations, three priority opportunities are identified:

3.3.1 Opportunity 1: Segregated HDPE Collection Infrastructure

- a. Install dedicated HDPE collection bins across 50 markets and high-density communities.
- b. Enable informal waste pickers to distinguish between film and rigid waste, reducing cross-contamination and improving quality of recyclate.

3.3.2 Opportunity 2: Pilot and Scale Localised HDPE Recycling

- a. Establish pilot MRFs in Accra and Kumasi with capacity to bale and pelletise HDPE film and rigid plastics.
- b. Integrate agglomeration technology for sachets and washing lines for rigid HDPE products.

3.3.3 Opportunity 3: Recycled Content Adoption in Manufacturing

- a. Promote use of recycled-HDPE pellets in new local manufacturing through voluntary producer agreements.
- b. Set a target for manufacturers to include $\geq 15\%$ recycled content in products such as containers and plastic ware by 2027.

3.4. Feasibility and Impact Assessment

Strategic action areas for HDPE circularity were assessed based on their feasibility and potential impact. This dual analysis helps identify which interventions can be implemented quickly, and which require more structural support. As summarised in Table 6, improving collection through segregation presents the most immediately feasible pathway, while scaling local recycling and driving recycled content adoption offer high long-term gains. Table 7 further distils these priorities by geography and product type, highlighting the need for coordinated efforts in both urban and coastal regions to unlock system-wide transformation.

Table 6. Feasibility and Impact Assessment

Opportunity	Feasibility	Impact	Justification
Segregated HDPE Collection Infrastructure	High (can use existing systems)	High (reduces contamination, boosts recovery)	Easily implementable using existing municipal and informal collection systems. Critical for improving HDPE waste quality and quantity.
Pilot and Scale Localised HDPE Recycling	Medium (requires capital)	High (closes loop, creates jobs)	Builds technical capacity within Ghana, reduces reliance on virgin imports, and strengthens recycling ecosystem.
Recycled Content Adoption in Manufacturing	Medium-Low (needs policy push)	Very High (reduces virgin resin use)	Reduces over 98% reliance on virgin plastics. Promotes market pull for recyclate and signals demand to investors. Requires EPR regulation and market development.

Table 7. Summary of Feasibility and Impact Assessment

Component	Details
Geographic Focus	Greater Accra, Ashanti (Kumasi), Central and Western Regions
HDPE Segments	Film (sachets, bags), Rigid (containers, bottles, drums)
Priority Opportunities	1. Segregated Collection Infrastructure 2. Localised HDPE Recycling Pilots 3. Recycled Content Mandates
Feasibility Ranking	Collection - High Recycling Infrastructure - Medium Content Adoption - Medium-Low
Impact Potential	High across all three due to immediate waste reduction, job creation, and material circularity gains



4. Stakeholder Mapping and Engagement Design

4.1.1. Key Stakeholders and Institutional Roles

The HDPE value chain in Ghana is supported and influenced by a broad range of stakeholders spanning government, private sector, informal actors, academia, and civil society. Each actor plays a critical role in shaping collection systems, recycling pathways, regulatory enforcement, and inclusive development of the circular economy. A coordinated, multi-stakeholder approach is essential for success.

4.1.2. Government Institutions

a. Environmental Protection Agency (EPA)

Mandate: Enforces environmental regulations, coordinates national plastic waste reduction targets, and oversees EPR frameworks. Key actor in setting recycled content standards and licensing recycling facilities.

b. Ministry of Environment, Science, Technology and Innovation (MESTI)

Mandate: Leads on circular economy policy development. Oversees national strategy implementation and supports integration of CE principles into sectoral policies.

c. Ministry of Local Government, Decentralisation and Rural Development (MLGDRD)

Mandate: Supports MMDAs in implementing local waste management by-laws. Critical for deploying community-based collection infrastructure and enabling partnerships with informal collectors.

d. Ministry of Trade and Industry (MoTI)

Mandate: Facilitates SME development in the recycling sector, supports innovation clusters, and shapes industrial policy related to polymer manufacturing.

e. Ghana Standards Authority (GSA)

Mandate: Develops and enforces standards for recycled plastic products. Pivotal in promoting safe use of rHDPE and ensuring quality assurance.

4.1.3. Private Sector and Industry

a. Producers and Importers (e.g. Unilever, Voltic, FanMilk)

Mandate: Major generators of HDPE packaging waste. Under future EPR regulations, they will be responsible for product take-back, reporting, and financing recycling systems.



b. Plastic Manufacturers and Converters

Mandate: Convert virgin or recycled HDPE into containers, bags, and industrial products. Their uptake of recyclate will be critical to market development.



c. Recyclers and Aggregators (e.g. Blowplast, Coliba, Kubet)

Mandate: Collect, wash, and reprocess HDPE into flakes or granules. Provide employment and link informal collectors to formal markets.



4.1.4. Informal Sector

Waste Pickers and Aggregators (Individual and Cooperatives)

Mandate: Recover HDPE from streets, households, markets, and landfills. Informal workers handle over 60% of HDPE recovery in Accra alone. They are central actors in the current collection system, though under-supported and largely unrecognised.

4.1.5. Civil Society and Development Partners

a. Ghana National Plastic Action Partnership (NPAP)

Mandate: Convening platform for national plastic waste dialogue. Provides evidence-based recommendations and international best practice insights

b. The OR Foundation

Mandate: Advocates for justice-centred circular economy. Supports data collection and capacity building among informal waste workers.

c. UNIDO

Mandate: Supports circular economy opportunity mapping and roadmap development. Provides technical assistance to value chain actors and facilitates cross-sector partnerships.

4.1.6. Academic and Research Institutions

KNUST, University of Ghana, University of Cape Coast

Mandate: Conduct research on polymer science, environmental impact, and material recovery systems. Offer training and analytical support for CE opportunity assessments.

4.2 Stakeholder Engagement Platforms

Achieving circularity in the HDPE value chain requires well-coordinated efforts across multiple actor groups. Each stakeholder brings unique capabilities. To ensure an inclusive and effective implementation of the HDPE roadmap, stakeholder dialogue must be systematic, recurring, and tailored to the realities of each actor group. Effective collaboration hinges not only on clearly defined roles but also on inclusive engagement platforms that enable dialogue, feedback, and co-creation. Table 8 outlines the principal stakeholder groups, their contributions to HDPE circularity, and the key channels through which sustained engagement can be fostered. Three structured engagement platforms are proposed:

a. Regional Design Labs

Hosted quarterly in priority regions (e.g. Greater Accra, Ashanti, Central), these labs will bring together local government, informal waste workers, SMEs, and recyclers to co-design practical interventions. Focus areas include logistics optimisation, infrastructure siting, and safety upgrades.

b. HDPE Value Chain Forums

These national forums will occur biannually and serve as a space for producers, recyclers, regulators, and academia to review performance data, align on market incentives, and address bottlenecks. Themes include: recycled content standards, rHDPE offtake agreements, and capital investment pipelines.

c. Listening Sessions and Demonstrations

Conducted monthly in communities, these sessions give voice to informal workers, households, and small retailers. Demonstrations will showcase new collection models, low-tech processing tools, and PPE innovations. These platforms will help build trust, ensure feedback loops, and boost adoption of circular practices.

Table 8. Stakeholder Roles and Engagement Channels - HDPE

Stakeholder Group	Key Institutions / Actors	Role in HDPE Circularity	Engagement Channel
Policy and Regulation	EPA, MESTI, MLGDRD, MoTI, GSA	Set CE policies, enforce standards, enable local action	Value Chain Forums, Regional Labs
Private Sector	FMCGs, HDPE manufacturers, recyclers	Finance EPR schemes, invest in recycling, adopt rHDPE	Value Chain Forums
Informal Sector	Waste pickers, scrap dealers, cooperatives	Collect over 60% of HDPE waste, operate grassroots networks	Listening Sessions, Regional Labs
Civil Society/ Development	OR Foundation, NPAP, UNIDO	Convene actors, fund pilots, strengthen data and advocacy	All Platforms
Academia and Training	KNUST, UCC, UG, vocational training bodies	Research, curriculum development, training of recyclers	Value Chain Forums, Regional Labs



5. Pillars, Levers and Enablers

In the context of circular economy planning, pillars represent the core areas of intervention, such as sustainable design, efficient collection, recycling, and inclusive livelihoods, that form the foundation of the system. Levers are the strategic actions or mechanisms used to drive change across these pillars, including policies, incentives, technologies, and partnerships. Enablers are the underlying support systems, like data, financing, capacity building, and stakeholder coordination, that make the implementation of levers and pillars effective and sustainable.

5.1. Strategic Pillars

5.1.1. Clean Energy Transition

The HDPE value chain, particularly in reprocessing, is energy-intensive. With over 22,000 tonnes of HDPE imported annually and less than 15% recovered through formal or semi-formal recycling systems, the opportunity to align recycling infrastructure with clean energy goals is substantial.

- a. Current recyclers operate small-scale machinery that runs on diesel or grid electricity, the latter of which is often interrupted or carbon-intensive.
- b. Powering flake washing lines and extrusion units with solar mini-grids could reduce emissions by over 30% and lower operating costs for SMEs in the long term.
- c. Prioritising clean energy retrofits for MRFs in Accra and Kumasi can serve as demonstrator sites for sustainable polymer recycling.

5.1.2. Waste Valorisation

HDPE waste, especially sachets and jerrycans, represents a high-volume but underutilised material stream.

Over 10,000 tonnes of HDPE sachet waste is generated yearly. If even 1 in 3 sachets were recovered and recycled,

this could displace the equivalent of over 1,500 tonnes of virgin resin annually.

- d. Valorisation models include upcycling into construction panels, broom handles, interlocking tiles, and non-food packaging, with potential value chain returns of GHS 4-6/kg.
- e. Investment in HDPE flake grading, colour sorting, and contamination removal is essential to ensure consistent market value.

5.1.3. Social Capital Strengthening

HDPE recovery is largely driven by informal workers, predominantly women and youth, who operate with minimal protection or recognition.

- a. Informal waste pickers account for the recovery of more than half of HDPE in Ghana's urban centres.
- b. Social capital interventions include cooperative formation, savings schemes, PPE distribution, and participatory safety training.
- c. Strengthening linkages between informal pickers and formal aggregators increases recovery volumes while improving livelihoods.

5.1.4. Inclusive Innovation

HDPE recycling presents a platform for innovation in both process and product.

- a. Decentralised agglomeration units can process sachets into briquettes closer to the source of waste generation, reducing transportation losses.
- b. Local entrepreneurs are already developing low-cost washing lines and densifiers using scrap parts, proof of grassroots ingenuity.
- c. Inclusion-focused innovation funds can catalyse ideas from youth innovators, women's cooperatives, and township recyclers.

5.2. Policy Instruments

5.2.1. Incentives for Circular Tech Adoption

- a. Fiscal incentives for HDPE recycling technology, such as VAT waivers or import duty reductions, can accelerate uptake of washers, extruders, and densifiers.
- b. SMEs cite upfront capital cost as a primary barrier to upgrading recycling capacity.

5.2.2. Certification Schemes

- a. There are currently no enforced standards for rHDPE content in products, which discourages offtake.
- b. GSA-supported certification for recyclate quality and safe secondary uses (e.g. non-food containers) is needed to boost market confidence.

5.2.3. Innovation Challenge Fund

- a. A targeted fund can incentivise innovations in HDPE collection, design for recyclability, and low-cost processing.
- b. Themes might include: sachet-to-panel prototypes, colour-free packaging redesigns, and smart sachet drop-off reward systems.

5.2.4. Quality Assurance

All HDPE flakes will be tested against ASTM D7209-06 and ISO 15270 standards for post-consumer recyclates. QA processes include:

- a. Melt Flow Index (MFI) verification for batch consistency;
- b. Visual inspection for pigment and label residue;
- c. Density separation tests to check cross-polymer contamination (e.g., presence of PP or LDPE);
- d. Moisture and ash content testing using standard lab methods

5.3. System Enablers

The following enablers highlight strategic interventions needed to embed circularity within community structures and governance systems. These interventions are not isolated; rather, they interact to drive environmental resilience, social equity, and economic viability within a locally adaptable circular economy framework. Table 9 presents the key pillars, levers, and enablers that together form the strategic backbone for scaling HDPE circularity across Ghana.

5.3.1. CE Toolkits for Local Governments

- a. MMDAs require practical tools to integrate CE thinking into local sanitation and waste bylaws.
- b. Toolkits will include HDPE leakage maps, public-private engagement models, and

5.3.2. Modular CE Training in Local Languages

- a. Most informal actors have no formal training. Modular courses in Twi, Ga, and Ewe will focus on material handling, value recognition, safety, and entrepreneurship.
- b. Training should be delivered in partnership with TVET institutions and NGOs already embedded in communities.

5.3.3. Mobile Data Tracking Tools


- a. Data on HDPE flows remains fragmented. Mobile-based systems that log volumes collected, prices paid, and destinations can close this gap.
- b. Tools like USSD-based dashboards can work offline and feed directly into municipal planning systems and national CE monitoring dashboards.

Table 9. Strategic Foundations for HDPE Circularity

Pillar / Lever / Enabler	Description	Impact Area
Clean Energy Transition	Solar-powered MRFs and extruders for lower GHGs and improved uptime	Environmental / Economic
Waste Valorisation	Recovery and upcycling of sachets and jerrycans into marketable products	Economic / Environmental
Social Capital Strengthening	Formalisation, training, PPE and cooperative formation for waste pickers	Social / Economic
Inclusive Innovation	Community-led tech solutions and product innovations using rHDPE	Social / Economic
Circular Tech Incentives	Reduced taxes/duties on recycling machinery	Economic
Certification Schemes	Standardisation of rHDPE products to build end-market trust	Economic / Regulatory
Innovation Challenge Fund	Competitive funding for HDPE solutions from youth and informal sector actors	Innovation / Social
CE Toolkits for Local Governments	Localised decision-support tools for planning CE infrastructure	Governance / Capacity
Modular CE Training	Basic skills training in local languages for material handling and micro-enterprise development	Capacity / Inclusion
Mobile Data Tracking Tools	Real-time HDPE recovery tracking for better planning and policy feedback	Monitoring / Efficiency

All pilot activities below directly respond to HDPE-specific hotspots and opportunity areas identified in baseline assessments, particularly those related to leakage in urban drains, low-quality recyclate, absence of formalised sorting infrastructure, and lack of downstream demand for recycled HDPE (rHDPE). Each pilot is grounded in existing initiatives, stakeholder capabilities, and material flow realities as documented in Accra, Kumasi, and other key zones.

Each pilot site will deploy appropriate reprocessing technologies, including:



Agglomerators:
Low-energy screw-type or friction agglomerators
(capacity: 0.5–1.5 tonnes/day);

Washing Lines: Batch or semi-continuous cold wash systems with **2–4 tonne/day** capacity, incorporating friction washers, hydrocyclones, and hot rinse tanks for label and detergent removal;

Extruders: Single or twin-screw extruders with degassing and screen changers for pelletising rigid HDPE, **capacity 1–2 tonnes/day.**

6. Pilot Design and Execution

6.1. Pilot 1: Decentralised HDPE Sorting and Drop-off Points in Urban Markets

6.1.1. Context and Rationale

Approximately 1 in 3 HDPE items generated in markets and high-footfall areas, particularly water sachets, detergent bottles, and jerrycans, are not collected systematically. Informal pickers focus on PET or metals due to clearer resale value. The absence of dedicated sorting and drop-off facilities leads to contamination, open burning, and drainage blockage. This pilot aims to create decentralised HDPE collection points at strategic market hubs in Accra, Kumasi, and Cape Coast.

6.1.2. Key Activities

- a. Install colour-coded HDPE bins (rigid and film) in 20 high-volume markets.
- b. Deploy trained waste liaison officers to support segregation and informal collector coordination.
- c. Establish data collection protocols using USSD-based volume tracking tools.
- d. Facilitate micro-payments or vouchers for drop-offs via partnerships with FMCGs and retailers.

6.1.3. Success Criteria

- a. Minimum **60 tonnes of HDPE collected** within 12 months across sites.
- b. At least **500 informal pickers** engaged and trained on HDPE value differentiation.
- c. Visible reduction in HDPE litter in pilot market surroundings (measured via monthly audits).

6.1.4. Stakeholders and Roles

- a. **MMDAs:** Site authorisation, monitoring and maintenance oversight.
- b. **Informal Collectors:** Daily aggregation, bin servicing, volume reporting.
- c. **FMCGs/Retailers:** Incentive provision, branding, co-financing.
- d. **The OR Foundation:** Technical support, training, and social impact evaluation.

6.2. Pilot 2: Mobile HDPE Agglomeration and Densification Units for Sachet Waste

6.2.1. Context and Rationale

HDPE film waste (notably water sachets) is among the most visibly mismanaged forms of plastic in Ghana. Sachet litter clogs drains, causes flash floods, and accounts for roughly 10 Olympic swimming pools' worth of waste annually. Most recyclers reject them due to high contamination and transport inefficiencies. This pilot introduces mobile agglomeration units that can process sachets into briquettes near source.

6.2.2. Key Activities

- a. Procure and deploy 3 mobile agglomerators with shredding and melting functionality.
- b. Partner with youth cooperatives to operate mobile units on a rotating basis across Accra, Tema, and Ashaiman.
- c. Develop linkages with construction material manufacturers for briquette offtake.
- d. Trial revenue-sharing schemes between cooperatives and downstream users.

6.2.3 Success Criteria

- a. 100 tonnes of sachet waste processed into construction-grade briquettes in 18 months.

- b. Agglomerator downtime below 10% due to maintenance and energy access planning.
- c. Positive income impact on at least 100 youth participants (measured through earnings tracking).

6.2.4. Stakeholders and Roles

- a. **Youth Cooperatives:** Daily operations, maintenance, and income tracking.
- b. **MoTI/TVET Institutions:** Skills training and equipment maintenance support.
- c. **Recyclers and Offtakers:** Purchase and trial briquette use in manufacturing.
- d. **UNIDO:** Equipment financing, performance monitoring, and data integration.

6.3. Pilot 3: HDPE Flake Quality Certification and Market Activation Platform

6.3.1. Context and Rationale

Despite over 60% of HDPE waste being collected informally, recyclers cite inconsistent flake quality, particularly contamination from labels, residues, and mixed colours. This constrains their ability to market rHDPE to manufacturers. This pilot introduces a simple, tiered certification system for HDPE flakes, bundled with a digital marketplace to connect sellers and buyers.

6.3.2. Key Activities

- a. Design flake quality standards with Ghana Standards Authority (GSA) and recyclers.
- b. Establish a 3-level flake certification protocol based on contamination and colour grade.
- c. Pilot a mobile-accessible digital marketplace for rHDPE flakes.
- d. Train informal recyclers on quality improvement methods and platform use.

6.3.3. Success Criteria

- a. At least 20 recyclers certified under the new flake quality system within 1 year.
- b. 100 tonnes of rHDPE sold through the digital platform by year-end.
- c. Manufacturer confidence in rHDPE use increases, measured by $\geq 10\%$ rise in rHDPE inclusion in select products.

6.3.4. Stakeholders and Roles

- a. **GSA:** Standards development and certification oversight.
- b. **Plastic Recyclers Association of Ghana (PRAG):** Pilot site selection and user recruitment.
- c. **Manufacturers:** Procurement from platform, feedback on rHDPE performance.
- d. **Digital Tech Partner:** Platform development, training, and support.

6.4. Pilot 4 (Proposed): HDPE Buy-Back Kiosks Integrated with Sachet Retail Outlets

6.4.1. Context and Rationale

Water sachet vendors are prolific in both urban and peri-urban areas, contributing significantly to HDPE waste. However, they also present a unique and underutilised opportunity for collection infrastructure. Buy-back kiosks situated at or near sachet retail outlets can create a closed-loop incentive model by rewarding customers who return HDPE waste.

6.4.2. Key Activities

- a. Set up 50 micro-kiosks next to sachet-selling shops in Accra, Tema, Tamale, and Cape Coast.
- b. Offer small rewards (e.g. 10 pesewas per 10 sachets or bottles returned).

- c. Use digital collection logs to record returns and track individual participation.
- d. Link kiosks to certified recyclers for regular pick-up and processing.

6.4.3. Success Criteria

- a. At least 2 million sachets or HDPE items recovered in 12 months.
- b. 20% repeat participation rate among consumers.
- c. Documented diversion from storm drains and public spaces.

6.4.4. Stakeholders and Roles

- a. Sachet Distributors:** Kiosk integration and customer outreach.
- b. Waste Aggregators:** Scheduled pick-ups and volume reporting.
- c. Local Authorities:** Provide kiosk permits and public sanitation alignment.
- d. Digital Partners:** Log development and SMS-based reward system.

6.5. Pilot 5 (Proposed): Modular HDPE Product Innovation Challenge in TVET Colleges

6.5.1. Context and Rationale

HDPE waste is a versatile feedstock, but there is limited downstream product diversification in Ghana beyond low-value items like bins and mats. Engaging technical universities and TVET institutions through a structured innovation challenge can catalyse new applications, from affordable construction panels to classroom furniture, while building skills in CE design. Table 10 presents five such pilots, each with a defined rationale, lead actors, and performance metrics over a 12–18-month horizon. Collectively, they aim to stimulate systemic change, foster innovation, and build confidence in Ghana’s ability to close the loop on HDPE waste.

6.5.2. Key Activities

- a. Launch a national challenge across 8 TVET colleges.
- b. Provide standardised rHDPE flake feedstock for prototyping.
- c. Include mentoring from local recyclers and industrial designers.
- d. Showcase and incubate winning products with potential offtakers.

6.5.3. Success Criteria

- a. 8-10 novel rHDPE-based prototypes developed.
- b. 3 products progress to commercial trial or incubation phase.
- c. 100 students trained in CE design and polymer reprocessing.

6.5.4. Stakeholders and Roles

- a. TVET Colleges** (e.g. Cape Coast Technical University): Host and train participants.
- b. UNIDO/MoTI:** Challenge facilitation and incubation support.
- c. Private Sector (e.g. construction firms):** Provide market testing opportunities.
- d. Standards Authority:** Advise on product quality and safety compliance

Table 10. HDPE Circular Pilot Interventions

Pilot Title	Rationale	Key Metric (12-18 months)	Lead Actors
Decentralised HDPE Sorting and Drop-off Points	Poor source segregation and littering in urban markets	≥60 tonnes HDPE recovered; 500+ collectors	MMDAs, OR Foundation, informal cooperatives
Mobile HDPE Agglomeration and Densification Units	Sachets clog drains and are rarely recycled due to poor density and contamination	100 tonnes sachets converted; 100 youth jobs	Youth groups, MoTI, UNIDO, recyclers
HDPE Flake Certification and Market Activation Platform	Recyclers face low demand due to inconsistent flake quality and lack of verified offtake market	100 tonnes sold via platform; 20 recyclers certified	GSA, PRAG, digital partners, manufacturers
HDPE Buy-Back Kiosks at Sachet Retail Outlets (Proposed)	Retailers generate HDPE waste but lack take-back incentives	2 million items recovered; 20% repeat users	Sachet distributors, aggregators, digital partners
Modular HDPE Innovation Challenge in TVETs (Proposed)	Lack of downstream innovation for rHDPE applications in Ghana	8-10 products; 3 scaled; 100 students trained	

This Action Plan translates HDPE-specific baseline findings into a phased rollout strategy over a 4-year horizon. It is structured to ensure that foundational gaps, such as poor segregation, low-grade recyclate, and limited downstream offtake, are addressed in the short term, followed by scaled demonstrations and institutionalisation. All actions are grounded in the previously identified hotspots, opportunities, and five pilot interventions.

7. Action Plan and Implementation Pathways

7.1. Short-Term Actions (Years 1-2): Foundation and Prototyping

These activities focus on addressing immediate inefficiencies in HDPE recovery, laying the groundwork for innovation and market trust.

- a. Establish 20 decentralised HDPE sorting/drop-off stations across urban markets in Accra, Kumasi, and Cape Coast (linked to Hotspot 3: low source segregation).
- b. Deploy 3 mobile agglomerators for sachet waste, with operator training and rotation plans in Accra, Ashaiman, and Tema (linked to Hotspot 1: sachet leakage into drains).
- c. Design and implement HDPE flake certification protocol with GSA and major recyclers (linked to Hotspot 2: low-quality rHDPE).
- d. Run awareness campaigns and participatory demos at pilot sites to encourage household-level HDPE separation and market participation.
- e. Launch modular CE training for informal workers and cooperatives involved in HDPE collection and processing.
- f. Initiate HDPE Buy-Back Kiosk pilot (Proposed) in 50 sachet retail outlets in urban/peri-urban areas.
- g. Secure seed funding and begin procurement for pilot activities, including innovation challenge materials.

7.2. Medium-Term Actions (Years 2-3): Demonstration and Consolidation

This phase builds on early lessons, focusing on scaling high-performing pilots and embedding trust in HDPE recycling markets.

- a. Expand the HDPE drop-off and sorting network to 50 markets, integrating digital volume tracking tools.
- b. Establish circular offtake partnerships between rHDPE producers and manufacturers, including trials of certified flakes in detergent and construction product packaging.
- c. Operationalise the rHDPE digital marketplace, matching certified recyclers with buyers.
- d. Scale mobile agglomerator coverage to 6 cities, with enhanced flake quality control and briquette standardisation.
- e. Roll out the Modular HDPE Innovation Challenge (Proposed) across 8 TVET colleges, including mentorship, judging, and incubation pathways.
- f. Embed CE monitoring tools in MMDA waste dashboards, particularly tracking HDPE leakage and recovery volumes.
- g. Strengthen institutional support and local ordinances promoting rHDPE product procurement by public entities (e.g. bins, panels).

7.3. Long-Term Actions (Years 3-4): Scaling, Policy Integration and Replication

This final phase institutionalises gains and positions HDPE circularity for national scaling and policy mainstreaming.

- a. Formalise HDPE flake certification as a national standard, supported by GSA and backed by enforcement guidelines.
- b. Integrate HDPE circular targets into MMDA waste plans and national CE strategy review cycles (aligned with Just Transition frameworks).

- c. Establish permanent buy-back networks and drop-off depots, supported by FMCGs and waste contractors.
- d. Convene national CE roundtables for HDPE product offtake, including plastics manufacturers, standards bodies, and informal cooperatives.
- e. Scale up innovation challenge winners, supporting them with de-risking finance, tooling access, and offtake MOUs.
- f. Replicate successful pilot interventions in Northern and Western regions, adapting to local material profiles and governance structures.

Table 11. HDPE Action Plan

Phase	Timeline	Key Outputs
Short-Term	Years 1-2	20 drop-off points, 3 mobile units deployed, 1 flake standard developed, kiosks prototyped
Medium-Term	Years 2-3	50 markets reached, 100 tonnes certified flakes traded, CE training scaled, TVET challenge
Long-Term	Years 3-4	Policy integration, rHDPE standards adopted, innovation products scaled, national replication

The MRV framework ensures that environmental, economic, and social outcomes tied to HDPE circularity interventions are systematically tracked, validated, and used to inform policy and scale-up decisions. Indicators below are directly linked to the five pilot interventions, identified hotspots, and the action plan timelines. To ensure that HDPE circularity initiatives deliver measurable results, a suite of Key Performance Indicators (KPIs) has been established across three critical dimensions: environmental integrity, economic viability, and social inclusion.

8. Monitoring, Reporting, and Verification (MRV)

These indicators go beyond simple output metrics, aiming to reflect real transformation in system performance and livelihoods. The tables that follow present selected KPIs with their 2024 baselines, 2027 targets, and methods for data collection, providing a grounded yet forward-looking framework to monitor impact and inform adaptive management. Table 12 outlines the environmental KPIs focused on waste recovery, pollution reduction, and material quality. Table 13 captures economic performance, including income generation, revenue growth, and enterprise development. Table 14 highlights social KPIs, emphasising participation, gender inclusion, youth engagement, and behaviour change at the household level.

All KPIs have been selected to be measurable, accessible, and aligned with Ghana’s national and local CE data frameworks.

Table 12. Environmental KPIs

Indicator	Baseline (2024)	Target (2027)	Source/Method
HDPE Collection Rate (%)	~50%	≥75%	Municipal collection records; periodic waste audits
HDPE Recycling Rate (%)	~10%	≥25%	Recycling plant throughput logs; third-party waste audits
Drainage Blockage Events due to HDPE	Frequent during wet season	≥50% reduction	MMDA sanitation incident reports; environmental surveys
rHDPE Flake Contamination (visual %)	>30%	≤10%	Lab-based sampling at recycler sites; GSA spot checks
rHDPE Product Replacement Ratio	<2% of total HDPE usage	≥15% in selected FMCG packaging	Manufacturer surveys; offtake reports; certification audits

Table 13. Economic KPIs

Indicator	Baseline (2024)	Target (2027)	Source/Method
Income from HDPE per Informal Worker (USD)	~GH¢5/day (approx. \$0.40)	≥GH¢15/day (approx. \$1.20)	Worker logs; income diaries; OR Foundation surveys
Revenue from rHDPE Sales (USD)	Variable and untracked	≥\$250,000/year from 5 pilots	Verified platform transactions; invoices; buyer feedback
Number of Active HDPE Recycling Ventures	~12 (formally registered)	≥30 (with certified flake sales)	Registrar records; PRAG database; flake certification logs
Product Innovation Incubated (count)	0 (no formal CE linkage)	≥5 new rHDPE products prototyped	TVET innovation challenge reports; pilot follow-up studies

Table 14. Social KPIs

Indicator	Baseline (2024)	Target (2027)	Source/Method
Informal Workers Participating in CE Pilots	<100	≥500 across all pilots	Workshop logs; cooperative enrolment records; event registers
Female Participation in CE Pilots (%)	~20%	≥40%	Attendance sheets; gender-disaggregated surveys
TVET Students Engaged in CE Innovation	0	≥100	TVET records; challenge entry and graduation data
Households Practising HDPE Segregation (%)	Est. <1 in 20	≥1 in 5	Household waste behaviour surveys; MMDA monitoring

8.1. Data Collection Tools

To support indicator tracking and verification, the following tools and platforms are used:

a. Mobile Logs

Used by informal collectors, recyclers, and kiosk managers to record daily volumes, earnings, and types of HDPE collected. USSD platforms and WhatsApp-based forms will enable easy entry and dashboard generation.

b. Periodic Audits

Conducted quarterly by third-party auditors and local universities to validate physical volumes, check contamination levels, and monitor material leakage into drains or landfills.

c. Household Surveys

Bi-annual surveys in target districts (e.g., Accra, Kumasi, Cape Coast) to assess behaviour change in HDPE disposal and segregation. These will also be used to assess satisfaction and awareness of drop-off points and kiosks.

d. Material Flow Analysis

Material Flow Analysis (MFA) for HDPE was modelled using STAN software v2.6, accounting for imports, conversion, collection, recycling, and leakage. Geospatial mapping of HDPE leakage hotspots (e.g., drains, markets, beaches) will be layered using ArcGIS to support MRV and adaptive planning

Table 15. MRV Dashboard Overview

Domain	No. of KPIs	Primary Tools	Verification Partners
Environmental	5	Waste audits, sanitation logs, lab samples	MMDAs, GSA, OR Foundation
Economic	4	Income logs, revenue tracking, sales reports	PRAG, recyclers, UNIDO
Social	4	Surveys, training records, platform analytics	TVETs, cooperatives, NGOs

The transition to circularity in Ghana's HDPE value chain hinges on catalytic funding, risk-sharing structures, and targeted investment tools. Current inefficiencies, particularly in segregation, agglomeration, and low-grade recyclate markets, cannot be overcome

by informal actors alone. This step outlines a structured financing pathway for the five priority HDPE interventions, grounded in costed action, appropriate capital sources, and mechanisms to attract blended finance.

Table 16. Cost Estimates for Priority HDPE Interventions

Intervention	Estimated Cost (USD)	Notes
Decentralised Sorting & Drop-off Infrastructure (20-50 sites)	\$450,000	Includes bins, signage, training, and early mobilisation
Mobile Agglomeration Units for Sachet Film Waste (3-6 units)	\$300,000	Covers machinery, maintenance, transport, and operator training
HDPE Flake Quality Certification System	\$150,000	GSA technical support, audits, verification platform
Buy-Back Kiosk Pilot in Sachet Retail Outlets (50 kiosks)	\$100,000	Rewards scheme, kiosk design, digital data tool, urban campaign
Modular TVET Innovation Challenge and Product Incubation	\$200,000	Design sprint, tools, mentors, and mini-grants for 3-5 winners

Total Estimated Pilot Portfolio (2024-2027): \$1.2 million

These costs reflect foundational investment only. Scale-up phases (especially for national replication of drop-off points and buy-back systems) will require an additional \$1.5-2 million across 3-5 years.



9. Financing Strategy and Investment Mobilisation

9.1. Funding Sources

9.1.1 Public Funding

- a. Ghana's National Plastics Action Partnership (NPAP) budget allocations to MMDAs and sanitation-focused CE initiatives.
- b. Ministry of Trade and Industry (MoTI) contributions under the circular industrial resource efficiency strategy.
- c. GETFund/TVET funding for institutional challenge delivery and student incubation.

9.1.2. Donor Agencies

- a. **UNIDO:** Technical assistance, capacity-building, and platform development.
- b. **GIZ/KOICA/World Bank:** Support for climate-resilient waste systems and urban green jobs.
- c. **Mastercard Foundation and EU Delegation:** Youth entrepreneurship and CE training.

9.1.3. Private Sector Co-Investment

- a. Sachet water producers and FMCGs via Extended Producer Responsibility (EPR) schemes.
- b. Local recyclers and aggregators investing in densification or quality upgrades.
- c. Infrastructure partners supporting kiosk and collection logistics.

9.2. De-Risking Mechanisms

To attract private investment in high-risk, low-margin HDPE ventures, de-risking instruments will be layered across interventions. These include:

- a. **Guarantee Funds:** Underwrite loans for recyclers purchasing mobile agglomerators or upgrading flake washing lines.
- b. **Innovation Prizes:** Offer \$5,000-10,000 seed grants for the top 3 rHDPE product prototypes emerging from the TVET challenge.
- c. **Output-Based Incentives:** Provide payments to recyclers and collectors for verified volumes of clean HDPE diverted from open burning or storm drains (pay-per-tonne basis).
- d. **Offtake Pre-Contracts:** Use of conditional MoUs from FMCGs to stimulate rHDPE product investment with assured demand.

9.3. Investment Instruments

a. Investment Prospectus (2024 Edition)

A national-level HDPE opportunity portfolio, detailing business models, ROI, social returns, and pipeline entrepreneurs, used to attract CSR funds, angel investors, and impact funds.

b. Challenge Fund

A \$250,000 pooled fund (target size) to be administered jointly by UNIDO and MoTI, aimed at supporting early-stage HDPE ventures aligned with national CE goals.

Table 17. Financing HDPE Circularity

Instrument	Purpose	Target Value	Delivery Partner(s)
Public Infrastructure Budget	Build sorting, kiosks, and drop-off centres	\$450,000+	MMDAs, MoTI
Donor Technical Support	Training, pilots, digital tools	\$350,000	UNIDO, GIZ, Mastercard Foundation
Private Sector Match via EPR	Equipment, flake certification, buy-back rewards	\$200,000	Water brands, recyclers
Innovation and De-risking Grants	Support TVET challenge and innovation prizes	\$200,000	MoTI, UNIDO, and bilateral agencies
Challenge Fund (target)	Venture co-financing and CE prototyping		

9.4 Operational Risks and Mitigation Measures

Implementing a circular economy roadmap for HDPE in Ghana presents several operational and systemic risks that could undermine the impact if not proactively addressed. These risks span technical, institutional, social, and market-related domains. Identifying and mitigating these challenges is essential to ensure the roadmap’s long-term viability, investor readiness, and inclusive benefits

Table 18. Operational Risk and Mitigation Measures

Risk	Description	Mitigation Strategy
Contamination of HDPE waste	Labels, residue, mixed polymer	Community training, colour-coded bins, and clear buyer specifications
Equipment downtime	Poor maintenance or energy gaps	Preventive maintenance contracts, solar retrofits
Low flake quality consistency	Variability in informal processing	Flake certification + lab testing SOPs
Market resistance to rHDPE	Perceived quality and safety concerns	QA protocols, pilot co-creation with brands
Informal worker exclusion	Elite capture of pilot benefits	Cooperative agreements, gender/youth targets

Addressing the systemic challenges in Ghana’s HDPE value chain requires targeted capacity development at multiple levels, from informal collectors and sorters to technical institutions and regulatory agencies. The documents reveal fragmented training systems, limited CE mainstreaming in TVET curricula, and poor data tracking at the district level. This step outlines how a modular training architecture, supported by institutional partnerships, can bridge these gaps while equipping actors to support HDPE circularity at scale.

10. Capacity Development and Institutional Strengthening

10.1. Modular CE Training Curriculum

A modular curriculum on circular HDPE will serve different actor groups across the ecosystem: informal workers, aggregators, MMDA officers, recyclers, policymakers, and TVET students. Each module will be tailored to the user's skill level and role in the value chain, blending core CE concepts with practical skills relevant to Ghana's HDPE hotspots.

10.1.1. Actors and Responsibilities:

- a. **UNIDO** - Overall coordination, ensuring curriculum aligns with international CE standards and tailored to Ghana's specific value chain dynamics. UNIDO will also host a digital version of the curriculum through its CE Hub.
- b. **Environmental Protection Agency (EPA)** - Will lead modules on environmental risk, GHG hotspots, and CE regulatory frameworks. EPA will integrate emissions data from HDPE waste burning into LCA training materials.
- c. **OR Foundation** - With deep informal sector engagement in Accra, OR will co-develop training modules for waste pickers, focusing on occupational health, gender inclusion, sorting practices, and mobile income logging.
- d. **Ghana Standards Authority (GSA)** - Will provide training on flake purity standards, contamination thresholds, testing protocols, and certification pathways for recyclers.
- e. **Kwame Nkrumah University of Science and Technology (KNUST)** - Will contribute expertise in CE diagnostics, MFA tools, and plastics reprocessing technologies. The university will support technical content on HDPE processing and modelling for decision-making.
- f. **University of Cape Coast (UCC)** - As the plastics value chain lead, UCC will deliver modules on data collection, social inclusion analysis, and linking HDPE interventions to development indicators.
- g. **Cape Coast Technical University (ATU)** - Will focus on fabrication, prototyping, and product development using rHDPE. This includes mould design and quality control.
- h. **National Vocational Training Institute (NVTI)** - Will deliver modules on HDPE collection, sorting, washing, extrusion, and informal-to-formal transition models. NVTI will also issue CE vocational certificates.
- i. **Plastic Recyclers and Aggregators of Ghana (PRAG)** - Will offer real-industry exposure, providing facility tours, hands-on sorting sessions, and market linkage modules. PRAG members will also mentor trainees.
- j. **Selected Municipal Assemblies (e.g., Accra Metropolitan Assembly, Kumasi Metropolitan Assembly)** - Will use CE modules to upskill frontline officers and sanitation staff on how to implement and track CE interventions.
- k. **Ministry of Education / TVET Secretariat** - Will integrate CE HDPE modules into national TVET curricula under a formalised accreditation framework.

Private Sector (e.g., Blowplast, Finepack, WAPCo) - Will co-develop modules on quality control, industrial-scale rHDPE usage, and circular design innovation from a manufacturer's perspective.

10.1.2. Modular training for informal actors and TVET students will cover:

- a. Basic CE principles and value chain economics;
- b. O&M of agglomerators, washers, and extruders;
- c. Contamination prevention and sorting protocols;
- d. Flake quality standards and melt flow testing;
- e. Digital tracking tools (USSD and smartphone);
- f. Health, safety, and PPE usage with focus on gender-sensitive needs

10.2. Extension Officer Upskilling

Ghana's decentralised waste governance model places sanitation officers and zonal extension staff at the front line of CE enforcement. Yet many lack the technical training to support or monitor circular practices.

Key Upskilling Areas:

- a. Circularity Fundamentals** - Training in CE principles, especially as applied to plastics. This includes concepts like design-for-recycling, closing material loops, and avoiding downcycling.
- b. Value Chain Mapping** - Using real data from the HDPE MFA, officers will learn how to identify leakage points, hotspots, and informal value nodes.
- c. Enforcement of Sorting at Source** - Extension staff will be trained to sensitise households and SMEs on HDPE segregation, supported by community-based monitoring tools.
- d. Mobile Data Entry** - Officers will learn to use digital platforms to log waste volumes, illegal dumpsites, and informal sector contributions.

e. Social Engagement Techniques - Training will also cover how to engage low-literacy and marginalised communities using visuals, local languages, and co-designed approaches.

Workshops will be staged in 8 priority districts over 2 years, supported by UNIDO and the EPA. These will include mock scenario training, certification, and field immersion.

10.3. Vocational Partnerships

As Ghana's circular transition depends on practical innovation, TVET institutions will play a pivotal role in producing the next generation of HDPE entrepreneurs and technicians. Partnerships will ensure CE becomes a live topic within mainstream vocational pathways.

Key Partnership Activities:

- a. HDPE Innovation Challenge** - A national design competition focused on rHDPE product solutions. The challenge will be run across 5-8 TVET schools and attract over 200 students annually. Winners will receive grants and business incubation support.
- b. Product Prototyping Labs** - Establishment of in-school maker labs where students can produce prototypes like roofing tiles, bins, crates, and soap dispensers using recovered HDPE.
- c. Industry Linkage Modules** - Hands-on placements at recycler facilities or plastic manufacturing companies. These placements will improve student employability and practical knowledge.
- d. Dual Certification Models** - Combining NVTI skills certificates with CE modules co-endorsed by GSA, UNIDO, and industry partners.
- e. Teacher Training** - Lecturers will receive upskilling in CE concepts and hands-on prototyping so they can effectively mentor student innovators.

10.4. Institutional Integration

To avoid one-off training and ensure long-term sustainability, CE capacity-building will be institutionalised in national planning and governance structures.

Key Integration Pathways:

- a. MMDA Planning Tools** - CE training indicators will be embedded in standard waste planning templates used by District Planning Coordinating Units (DPCUs), supported by NDPC.
- b. Waste Management Strategy Integration** - Local Waste Management Plans will include HDPE-specific CE indicators and capacity needs, making training and technical support part of budgeting and monitoring.
- c. National Skills Strategy** - TVET CE training targets will be linked to the Ministry of Education's sector performance indicators under Ghana's Medium-Term Development Policy Framework (MTDPF).
- d. CE Sub-Committee under NPAP** - Will coordinate capacity efforts across institutions, monitor curriculum uptake, and develop annual training scorecards.

Table 19. Institutional Capacity Framework for HDPE Circularity

Capacity Area	Lead Actors	Expected Outputs by 2027
Modular Training Curriculum	UNIDO, EPA, OR Foundation, NVTI, GSA, KNUST, UCC, PRAG, ATU	12 CE-HDPE modules; 600+ certified learners
Extension Officer Upskilling	MMDAs, EPA, UNIDO	120+ officers trained; CE embedded in district-level enforcement
Vocational Partnerships	TVET Secretariat, KNUST, NVTI, PRAG, private sector	5 national challenges, 50+ prototypes, CE certified vocational streams
Institutional Integration	NDPC, MoE, MMDAs, CE Sub-Committee	CE included in TVET policy, district planning, and waste strategy tools



11. Governance and Integration Framework

A high-functioning circular economy governance structure is essential to ensure continuity, accountability, and systemic coordination, especially in managing HDPE, which flows across both formal and informal domains, and from household sachets to industrial containers. The current fragmentation in policy ownership (waste, standards, urban planning, education, and trade) and the predominance of informal operators in collection, sorting, and resale demand a multi-tiered, inter-agency governance system. This step consolidates all oversight, planning, and regulatory functions relevant to HDPE circularity across national, regional, and district levels, ensuring alignment with both the Plastics Waste-to-Wealth initiative and Ghana's broader circular economy ambitions.

11.1. Multi-Level Governance Structure

11.1.1. National Level

At the apex, the National Plastic Action Partnership (NPAP), under the Ministry of Environment, Science and Technology (MEST), remains the anchor platform for plastics-related CE governance. A dedicated HDPE Sub-Committee will be established under the existing NPAP CE Technical Working Group to:

- a. Oversee the implementation of HDPE pilots and mainstream circularity into national plastics strategies.
- b. Coordinate actors such as GSA, EPA, UNIDO, Ghana Enterprises Agency, MoTI, MoE, and TVET institutions.
- c. Maintain an up-to-date national HDPE dashboard incorporating data from Material Flow Analysis (MFA), flake certification audits, and MRV tools.
- d. Approve CE training curricula and issue joint endorsements with education and standards bodies.

11.1.2. Key National Stakeholders:

- a. MEST (policy leadership)
- b. Ministry of Trade and Industry (circular markets, SME scaling)
- c. EPA (compliance and emissions tracking)
- d. Ghana Standards Authority (flake quality certification)
- e. NDPC (integration into planning tools)
- f. MoE/TVET Secretariat (curriculum uptake and skills policy)
- g. UNIDO (technical coordination and investment facilitation)

11.1.3. Regional Level

Regions act as coordination bridges between national policies and district implementation. CE focal persons within Regional Coordinating Councils (RCCs) will be appointed to:

- a. Collate pilot outcomes across districts (e.g. mobile agglomeration, drop-off centres).
- b. Report implementation status of regional CE strategies back to the NPAP sub-committee.
- c. Support rollout of HDPE innovation challenges through TVET hubs.
- d. Convene Regional CE Design Labs quarterly, bringing together waste actors, recyclers, and entrepreneurs to resolve bottlenecks and share innovation.

11.1.4. District Level

Given that 1 in every 2 PET and HDPE items are discarded at household level, MMDAs are the most proximate and crucial governance tier for action. District roles will include:

- a. Embedding HDPE metrics and CE activities into District Medium-Term Development Plans (DMTDPs) and Waste Management Strategies.
- b. Overseeing community segregation at source, buy-back kiosks, and monitoring of informal drop-off sites.
- c. Managing public-private partnerships for HDPE infrastructure.
- d. Coordinating local behavioural campaigns and facilitating Listening Sessions and Pilot Demonstrations.

CE governance will be led by District Planning Coordinating Units (DPCUs) in collaboration with Environmental Health Departments, ensuring technical and community linkages.

11.2. Integration into National Planning and Policy Systems

The HDPE roadmap aligns closely with existing national frameworks, enabling policy coherence and institutional anchoring. Key integration pathways include:

- a. **District Development Planning Guidelines** (NDPC): CE-related HDPE indicators (e.g. tonnes diverted, % recyclate in municipal procurement) will be embedded into planning templates used by all 261 MMDAs.
- b. **National Plastics Management Policy:** The policy's Extended Producer Responsibility (EPR) provisions will be leveraged to formalise sachet producers' support for buy-back kiosks, flake quality assurance, and co-investment in rHDPE markets.
- c. **TVET Strategy 2023-2027:** CE HDPE modules will be formally adopted by MoE, enabling skill recognition and national CE workforce tracking.

d. Climate and Urban Resilience Plans:

Given HDPE's role in clogging drainage systems, CE interventions (e.g. storm-drain drop-off points, collection by youth brigades) will be included in urban disaster risk reduction strategies.

- e. **Green Jobs Strategy (MoELR):** CE entrepreneurship from TVET pathways will be linked to job creation targets under the national green jobs framework.

11.3. Institutionalisation and Oversight

Sustained delivery of the roadmap depends on clear oversight responsibilities, monitoring, and long-term system embedding. This will include:

- a. **Annual CE Scorecards** issued by the NPAP HDPE Sub-Committee, tracking national and district-level performance across MRV indicators (collection rate, rHDPE content, training uptake).
- b. **Legally-Binding District Resolutions** that mandate CE provisions in new waste contracts, especially for HDPE.
- c. **Public Procurement Levers:** Government institutions will begin specifying rHDPE content in goods procurement (e.g. bins, piping), based on GSA-certified recyclate.
- d. **Formalisation Protocols for Informal Collectors:** District Assemblies, with OR Foundation and PRAG, will develop a lightweight registration and incentive system for informal actors, with data-sharing and co-branding features.
- e. **Integration with EPR Audits:** Oversight of EPR compliance by producers will include checks on their contribution to CE training, HDPE recovery pilots, and support to recyclers using certified flakes.

Table 20. HDPE Governance and Integration Framework

Governance Level	Institutions/Platforms	Functions
National	NPAP CE Working Group, HDPE Sub-Committee, MESTI, GSA, UNIDO	Policy coordination, technical standards, national MRV, curriculum approvals
Regional	Regional Coordinating Councils, TVET Hubs	Pilot replication, data collation, innovation forums
District	MMDAs, DPCUs, Environmental Health Departments	Planning integration, pilot oversight, community mobilisation
Integration	NDPC, MoE, MoTI, EPA, TVET Secretariat	Policy and plan alignment, budget anchoring, institutionalisation of CE practices
Oversight	NPAP Sub-Committee, GSA, OR Foundation, PRAG	Scorecards, flake certification monitoring, informal actor recognition, EPR audit coordination

Shifting Ghana’s HDPE management practices from disposal to circularity is not simply a technical or infrastructure issue, it is fundamentally a behavioural challenge. Most HDPE packaging, especially flexible formats like water sachets and shopping bags, is discarded shortly after single use, often into open drains or burnt in household compounds. With over **1 in 3 Ghanaian households** relying on HDPE sachet water daily, and many unaware of its recyclability, tailored messaging, cultural relevance, and community ownership are essential to shift habits. This step outlines an integrated communication and behavioural change strategy grounded in local realities and mapped to identified leakage hotspots.

12. Communications, Behavioural Change and Cultural Shifts

12.1. Storytelling and Recognition

12.1.1. Community Videos

Short documentary-style videos (3-5 minutes) will spotlight informal HDPE collectors, women-led recycling enterprises, and youth innovators transforming rHDPE into new products. These will:

- Be co-produced with local content creators in Ga, Twi, Ewe, and Hausa.
- Focus on relatable stories from hotspots like Agbogbloshie, Madina Market, and Takoradi suburbs.
- Be screened at community events, schools, TVET campuses, and shared via WhatsApp and Facebook.

12.1.2. Annual Awards

To incentivise excellence, an Annual CE Champions Awards scheme will be launched. Categories include:

- Best Female Collector (HDPE)
- Cleanest Community (based on HDPE litter reduction)
- Best TVET HDPE Innovation
- CE Educator of the Year
- Best MMDA of the year

Winners receive cash prizes, branded kits, and seed funding, backed by the private sector and EPR contributors.

12.1.3. Plastic Diaries

An interactive project where schoolchildren and community members document one week of plastic use and disposal. The resulting “diaries” will be exhibited publicly and used as educational tools to trigger reflective dialogue.

12.1.4. Influencer-Led Challenges

Local musicians, TikTok personalities and content creators will be engaged in the “Sachet Second Life” challenge to creatively reuse or redesign water sachets and other HDPE waste.

12.2. Local Language and Low-Literacy Messaging

12.2.1. Radio Campaigns

With over 70% radio listenership in rural and peri-urban areas, radio jingle series will be broadcast across 12 local stations. These will:

- Focus on key behaviour shifts: not burning HDPE, separating waste at source, and returning sachets.
- Feature dialogues, testimonials from informal pickers, and quiz formats with prizes.
- Be aired during peak times (morning and evening) in major languages: Akan, Ga, Ewe, Hausa, and Dagbani.

12.2.2 Murals and Visuals

Large-format murals will be painted in HDPE hotspots, particularly around markets, bus stations, and coastal communities. They will:

- Depict visual instructions on sorting sachets and HDPE packaging.
- Use symbolic colour codes to associate material types with bins or return kiosks.
- Be co-designed by local artists and youth groups.

12.2.3. Recyclopedia Posters

Visual posters (“HDPE Recyclopedia”) will show real-life examples of HDPE items that are recyclable vs. non-recyclable, with photos of actual Ghanaian products and brand packaging, translated into pictorial guides.

12.2.4. Plastic Whisperer Characters

A comic-style mascot called “The Plastic Whisperer” will be introduced in children’s corners, school clubs, and sanitation outreaches. The character, equipped with a cape and flake scanner, will personify HDPE recovery heroes.

12.3. Community-Led Channels

12.3.1. Zonal CE Committees

Each participating MMDA will establish Zonal CE Committees, comprising market queens, youth leaders, waste pickers, and school representatives. These will:

Facilitate community-based sorting days and feedback on HDPE pilot performance.

Act as liaisons between households and local CE taskforces.

Organise clean-up days with built-in sachet returns and prize raffles.

12.3.2. Faith-Based Campaigns

Engagement with churches, mosques, and traditional leaders will ensure CE messages are embedded into sermons, communal announcements, and naming ceremonies. Local faith institutions will be supported with HDPE return bins and sermon guidebooks on environmental stewardship.

12.3.3 Plastic Return School Clubs

Schools near high-leakage areas (e.g. Kasoa, Adenta, Tamale Central) will establish Plastic Return Clubs where pupils bring back HDPE items weekly in exchange for points, which can be converted to school supplies or prizes. Each school will appoint “CE Ambassadors” and maintain visual dashboards of collected material.

Table 21. Behavioural Change and Communications Strategy for HDPE

Channel	Tool/Activity	Purpose	Target Audience
Storytelling	Community videos, awards, influencer challenges	Inspire and normalise HDPE circularity	Youth, informal workers, public
Audio Messaging	Radio jingles, interviews, quizzes	Mass reach in low-literacy areas	Peri-urban and rural households
Visual Aids	Murals, Recyclopedia posters, Plastic Whisperer comics	Simplify instructions, improve recognition	Low-literacy and school audiences
Community Structures	Zonal CE Committees, school clubs, faith groups	Institutionalise CE behaviours locally	Households, pupils, congregations
Feedback and Ownership	Diaries, club competitions, zonal scorecards	Foster personal responsibility and community pride	General public, youth, educators

This step consolidates five HDPE-related pilots into three investment-ready business models that reflect opportunities mapped across the value chain, from upstream production inefficiencies and leakage hotspots, to downstream reuse and recycling barriers. These models were derived from demonstrable baseline challenges (Steps 2 and 3), refined through community and institutional engagement (Steps 4-6), costed and scheduled (Steps 7-9), and aligned to key KPIs (Step 8). Each model targets one or more CE archetypes, resource recovery, circular inputs, or design-for-circularity, and is designed for measurable environmental, economic, and social impact.

Table 22. Circular Business Models Identified

Business Model	Typology	Problem Addressed	Core Opportunity
Mobile Agglomeration Micro-Enterprises	Resource Recovery	1 in 2 HDPE sachets discarded in open areas; flake supply shortages for recyclers	Enable peri-urban waste pickers to convert sachets into clean, transportable agglomerate at source
Drop-Off & Incentive Kiosk Network	Reverse Logistics	Lack of consumer return channels; informal pickers overburdened by dispersed volumes	Install kiosks at schools, markets and transport hubs to aggregate sachets and HDPE packaging, with incentives
Flake Quality Certification & Aggregation Hubs	Circular Input Market	Only ~2% rHDPE used in Ghana's domestic production; lack of flake quality assurance	Support certified flake hubs with sorting tech and logistics for consistent rHDPE supply to manufacturers

These three models are mapped to the following previously identified hotspots:

- Hotspot 2: Virgin-dominant manufacturing (addresses through rHDPE market integration)
- Hotspot 3: Low post-consumer collection of HDPE sachets (addresses through kiosks and mobile systems)
- Hotspot 4: Informal and unsafe processing (addresses through decentralised agglomeration)

As shown in **Table 23**, these models present promising returns across multiple dimensions. However, realising their full potential will depend on strategic investments and enabling conditions. **Table 24** outlines the readiness pillars and support mechanisms necessary to drive uptake, ensure policy alignment, and secure end-market confidence.

Table 23. Projected Returns by Model

Model	Economic Return	Environmental Return	Social Return
Mobile Agglomeration Micro-Enterprises	Up to \$1,200/month per unit; 300-500 kg/month in flake feed-stock	Diverts 6 tonnes/month of sachets from drains and open burning	Empowers youth and women in peri-urban zones; builds ownership at community level
Drop-Off & Incentive Kiosk Network	Local vendors earn ~GHS 2 per kg returned; supports EPR tracking	Enables recovery of ~10 tonnes/month in high-density zones	Builds consumer habit; school-based schemes reinforce CE education
Flake Certification & Aggregation Hubs	Enables scale-up of rHDPE integration in packaging by 10-15% per annum	Cuts lifecycle GHGs by ~2.5 tonnes CO ₂ e per tonne of virgin HDPE avoided	Formalises informal recyclers; introduces safety, traceability, and dignity

Table 24. Readiness Pillars and Support Needs

Readiness Pillar	Support Needs
Technical Readiness	Low-cost agglomerators; certified flake sorters; kiosk data-tracking kits
Financial Viability	GHS 50,000-70,000 per unit for mobile micro-enterprises; EPR-backed seed grants
Policy & Regulatory Fit	Alignment with National Plastics Policy; flake certification through GSA
Market Development	Buyer linkages with brands; procurement incentives for rHDPE-based public goods

13. Circular Business Model Incubation and Scaling

13.1. Incubation Support Mechanisms

To translate promising HDPE solutions into sustained impact, targeted incubation mechanisms are being deployed to nurture innovation, build capacity, and connect entrepreneurs to markets. Activities such as Demo Days, Innovation Roundtables, and Pre-Incubation Training provide a structured pathway for ideation, validation, and policy alignment. These are reinforced through access to shared tooling and makerspaces, particularly benefiting TVET graduates and informal innovators.

Table 25 outlines the phased scaling strategy, moving from early proof-of-concept pilots to institutional partnerships and regional expansion.

Table 26 further distils how each business model aligns with key circular economy indicators, addresses specific system hotspots, and links directly to ongoing or proposed pilots designed to test viability and impact on the ground. Together, these efforts create a pipeline of investible solutions positioned for replication and long-term integration into Ghana's HDPE value chain.

a. Demo Days

Held twice annually in Accra, Kumasi, and Tamale, enabling CE entrepreneurs to pitch HDPE solutions to municipal buyers, NGOs, and donors. Focused on upcycled products, flake logistics, and new take-back models.

b. Innovation Roundtables

Quarterly forums hosted under the CE Sub-Committee of NPAP to bring together policy-makers, recyclers, EPR managers, and entrepreneurs. Used to review MRV data and adjust CE investment strategies for HDPE.

c. Pre-Incubation Training

Delivered by TVET institutions (e.g. Takoradi Technical, Accra Technical), focused on CE entrepreneurship, HDPE waste handling, basic accounting, and cooperative registration.

d. Access to Makerspaces and Shared Tooling

CE Innovation Centres to offer access to plastic presses, extruders, and packaging redesign tools, especially targeting TVET graduates and informal sector innovators.

Table 25. Scaling Path

Phase	Timeline	Key Outputs
Proof-of-Concept	Years 1-2	10 mobile units deployed; 15 kiosks operational; 2 pilot flake hubs certified
Institutional Partnerships	Years 2-3	Kiosks embedded in MMDA sanitation plans; rHDPE procurement clauses included in 2 government tenders
Regional Replication	Years 3-4	Expansion to 6 additional MMDAs across Bono East, Ashanti, and Northern Ghana

Table 26. HDPE Circular Business Models - Incubation and Scaling

Model	Typology	KPIs Linked	Hotspots Addressed	Pilot(s)
Mobile Agglomeration Enterprises	Resource Recovery	Recovery Rate (%), GHG reduction, income levels	Hotspot 3, 4	Pilot 1
Drop-Off & Incentive Kiosk Network	Reverse Logistics	Return volume, Consumer engagement index	Hotspot 3	Pilot 2
Flake Certification & Aggregation Hubs	Circular Input Markets	% rHDPE in products, emissions avoided, job formalisation	Hotspot 2, 4	Pilot 3

13.2. Alignment to the Project M&E

This HDPE Circular Economy Roadmap is designed not only to address material inefficiencies and unlock high-potential circular interventions but to directly support the overarching Monitoring and Evaluation (M&E) strategy of the Plastics Waste to Wealth programme. All 13 roadmap steps have been mapped to relevant M&E components, ensuring consistency with the project’s logical framework, from input to long-term impact.

13.2.1. Environmental Tracking

The roadmap includes environmental KPIs tightly aligned to project indicators in the logframe.

- HDPE diversion from open environments will be tracked by volume. For instance, if Pilot 1 (rHDPE Product Innovation Cluster) processes just 5 tonnes/week, that equates to over 250 tonnes/year, roughly the plastic weight of 1,000 buses. By 2026, combined pilots aim to divert over 1,000 tonnes of HDPE from landfills and drainage pathways annually, directly reducing urban flooding and solid waste burdens in hotspot districts.
- Recycled content in local product manufacturing is another tracked metric. Currently, under 2% of manufactured HDPE products use recycled input. Through Pilot 2 and Pilot 3, the roadmap targets reaching at least 15% recycled HDPE content in selected local products by 2027, monitored via product testing and producer reporting.
- Drainage clearance and flood risk reduction, an indirect but powerful environmental proxy, will be monitored especially in peri-urban zones like Kumasi and Ashaiman, where open dumping of HDPE sachets and containers contributes to 1 in 3 drainage blockages during rainy months.

These indicators are embedded in the roadmap’s Steps 2, 6, 8, and 13 and align with environmental M&E markers on material recovery, environmental stress mitigation, and polymer repurposing.

13.2.2. Economic Inclusion

The M&E indicators include employment, income improvement, and financial leverage, each reflected in this roadmap.

- Income uplift for informal workers and micro-enterprises:** HDPE roadmap pilots are expected to increase average daily earnings of informal collectors and sorters by 30–50%, particularly by integrating digital collection systems and off-take guarantees. For example, if the baseline income is GHS 30/day (~USD 2.50), the target uplift is to GHS 45–60 (~USD 4–5), verified through pilot-level surveys and enterprise records.

b. Cost-efficiency in HDPE recovery systems: The roadmap anticipates reducing the average cost per tonne of recovered HDPE from current rates of GHS 3,000–3,500 (~USD 250–300) to below GHS 2,200 (~USD 180) through improved sorting hubs, machine automation, and bulk logistics partnerships.

c. Finance mobilisation: The project M&E targets significant co-financing. Through Pilot 4 (certified flake aggregation) and proposed Pilot 5 (HDPE Innovation Incubator), the roadmap aims to mobilise USD 1.2 million in private sector and donor co-investments across the next 36 months.

These economic outcomes are captured in the roadmap’s Steps 7, 9, and 13 and mirror PMF indicators under co-financing, job creation, and cost reduction.

13.2.3. Social Inclusion and Cultural Change

The roadmap integrates measurable indicators for gender equity, youth empowerment, and behavioural shifts.

a. Women’s participation in CE enterprises: The project M&E system has a target that **60–70%** of hired and trained personnel should be women. The roadmap directly supports this through Pilots 1 and 2, as

well as CE Training Modules (Step 10), with **70%** of the planned 500 trainees expected to be female by **2027**.

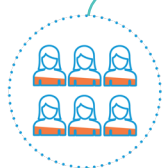
a. Youth engagement: HDPE-specific modules are expected to be rolled out in about 5 TVET institutions, targeting over **150 youth** annually. Youth-led microenterprises are expected to emerge from at least 3 out of the 5 identified pilots, supported by makerspaces and innovation grants.

a. Behavioural change and awareness: Campaigns rolled out in Ashaiman, Madina, and Kumasi Metro will focus on HDPE segregation and value. Pre/post-campaign surveys, part of the M&E framework, will track community understanding, reporting improvements of **40–60%** in awareness on the recyclability of sachets, bottles, and jerry cans.

These link directly to Steps 10 and 12 in the roadmap and mirror the PMF’s social indicators for inclusion, participation, and mindset shifts.

13.2.4. Tools and Verification Methods

The M&E strategy details specific verification methods that are integrated into this roadmap’s implementation approach:



a. Mobile data tracking tools will be used in HDPE sorting and aggregation pilots to capture collection volumes and product flow in real time. These are part of Step 8’s MRV system and align with PMF methods.



b. Quarterly performance audits will be applied to new rHDPE facilities and microenterprises, covering machinery usage, safety, and income benchmarks.



c. Household surveys and spot checks will be conducted across project zones to assess segregation practices, awareness, and livelihood outcomes, linked to Steps 6, 10, and 12.

This triangulation approach improves both data credibility and responsiveness across pilot and scale-up phases.

13.2.5. Learning Loops and Adaptive Management

To enable adaptive learning and continual improvement, the roadmap supports a feedback-rich implementation cycle:

- a. Quarterly stakeholder reviews will be held at regional level, aligning with roadmap Step 11. These reviews will assess pilot outcomes, surface local insights, and allow mid-course adjustments.
- b. Annual learning forums, coordinated with partners like EPA and OR Foundation, will disseminate lessons across Ghana’s wider CE community, supporting cross-learning among districts and sectors.
- c. Real-time performance triggers built into Pilot 3 (HDPE-Municipal Collaboration) will inform expansion or adjustment based on leakage reductions, cost-efficiency, and gender inclusion indicators.

Table 27. Summary of Alignment

M&E Focus Area	Roadmap Steps Linked	PMF/M&E Indicator Reference	Measurement Tools
Environmental Tracking	Steps 2, 6, 8, 13	Recovered volume, recycled content	Mobile logs, audits, flake content tests
Economic Inclusion	Steps 7, 9, 13	Jobs created, income uplift, co-finance	Enterprise surveys, finance reports
Social Inclusion	Steps 10, 12	% women/youth in training and jobs	Attendance logs, pilot-level HR records
Behaviour Change	Steps 6, 12	Community adoption of CE practices	Household surveys, campaign assessments
Verification Tools	Step 8	Data credibility and process audit	Mobile tools, site visits, audit logs
Learning and Adaptation	Steps 11, 13	Adjustments to roadmap/pilot design	Review forums, pilot performance dashboards

14 Conclusion

This roadmap offers a focused, data-driven and implementable strategy for unlocking the circular potential of High-Density Polyethylene (HDPE) in Ghana. By addressing critical leakage points, prioritising inclusive value capture, and embedding pilots within a wider enabling ecosystem, it transforms HDPE from an unmanaged waste stream into a driver of regenerative economic growth.

With five targeted interventions, including decentralised sorting hubs, rHDPE certification, and institutional return schemes, this roadmap is designed to shift both system performance and stakeholder behaviour. Each intervention is grounded in material flow and life cycle evidence, and linked directly to the national CE M&E framework to ensure transparent tracking of environmental, economic, and social impact.

The approach is not only about diverting waste; it is about formalising jobs, restoring material value, building trust across value chain actors, and ensuring that Ghana's transition to circularity is inclusive, scalable, and locally rooted. If fully implemented, this roadmap will enable Ghana to significantly increase HDPE recovery rates, reduce dependency on virgin plastics, expand access to certified recyclate, and support over 500 informal workers, while keeping the equivalent of multiple Olympic pools' worth of HDPE out of drains, dumps, and ecosystems each year.

In doing so, HDPE becomes not just a polymer type to manage, but a national asset to mobilise, supporting Ghana's broader vision for industrial resilience, green job creation, and environmental regeneration.

APPENDIX

Appendix: Roadmap KPI Matrix

The table below presents all identifiable KPIs categorised as either vertical (function-specific) or horizontal (cross-cutting). Each entry includes:

Baseline metric: Value or condition at roadmap start.

KPI: The measurable target or output to be achieved.

Action required: The intervention/activity that drives change.

Broader CE indicator: Overarching theme the KPI contributes to.

KPI Category: Vertical or horizontal.

TBL Score: Triple Bottom Line impact (Economy, Environment, Social), each rated out of 5.

Table 28. Roadmap KPI Matrix

Baseline Metric	KPI	Action Required	Broader CE Indicator	Category	TBL Score (Econ. Env.Soc)
~50% HDPE collection rate	Increase HDPE collection rate to $\geq 75\%$	Expand municipal schemes, incentivise informal collectors	Material Recovery	Horizontal	4.4.5
~10% HDPE recycling rate	Increase recycling rate to $\geq 25\%$	Support sortation hubs and formal processing capacity	Recycling Efficiency	Horizontal	4.5.5
<2% recycled HDPE in products	Achieve $\geq 15\%$ recycled HDPE content	Mandate recycled content, support manufacturers	Circular Input Use	Vertical	4.4.3
1 operational HDPE sortation hub	4 regional HDPE sorting hubs operational	Scale pilot in Accra, replicate in 3 more zones	Infrastructure Deployment	Vertical	3.5.4
No HDPE buyback models	Launch 3 HDPE buyback schemes	Incentivise community collection with price floor guarantees	Inclusive Recovery	Horizontal	3.3.4
No district plans include HDPE CE targets	3 districts integrate HDPE CE KPIs	Policy engagement and planning support	Policy Mainstreaming	Horizontal	2.3.4
No CE skills modules on HDPE	500 actors trained in HDPE CE practices	Deliver modular training in CE, safety, business	Capacity Development	Vertical	3.2.4

Baseline Metric	KPI	Action Required	Broader CE Indicator	Category	TBL Score (Econ. Env.Soc)
0 digital tracking of HDPE flows	Pilot mobile-based tracking in 2 regions	Equip MMDAs, train data agents	Digital MRV	Vertical	2.3.4
No HDPE reuse innovations	Develop 2 HDPE reuse products	Launch design challenge, prototype trials	Innovation & Design	Vertical	3.3.3
Low participation of women in HDPE value chain	Achieve ≥40% women participation in pilots	Target women-led coops, inclusive recruitment	Gender Equity	Horizontal	2.2.5
No formal markets for recycled HDPE	3 functional market linkages	Broker offtake agreements, host B2B roundtables	Market Development	Horizontal	4.3.4
0 CE modules in UCC/KNUST	Embed CE into 2 university curricula	Develop course content, partner with departments	Institutional Integration	Horizontal	2.2.3
No HDPE-focused radio campaigns	2 local radio campaigns launched	Translate messages into local languages, air weekly	Behavioural Change	Horizontal	2.1.4
0 HDPE murals/visual campaigns	3 murals painted in hotspots	Partner artists with MMDAs and youth groups	Low-Literacy Messaging	Horizontal	1.2.4
0 vocational CE courses	100 students trained via vocational centres	Partner NVTI & TVET institutions for CE modules	Vocational CE Pathways	Vertical	3.1.4
No gender-specific CE measures	Gender lens applied to all pilots	Design pilots with GESI lens and safe spaces	Gender Mainstreaming	Horizontal	2.1.5
No HDPE recovery from schools	20 schools engaged in HDPE return programmes	Deploy bins and partner with teachers	Youth Engagement	Horizontal	2.2.4
0 demonstration pilots in peri-urban areas	2 peri-urban CE pilots launched	Adapt hub design for decentralised systems	Spatial Inclusion	Horizontal	3.3.3

Baseline Metric	KPI	Action Required	Broader CE Indicator	Category	TBL Score (Econ. Env.Soc)
0 Innovation Showcases held	Annual Demo Days institutionalised	Host 1 national, 2 regional showcases/year	CE Innovation Ecosystem	Horizontal	4.3.3
No tools for CE planners	3 CE toolkits deployed to MMDAs	Design planning and monitoring templates	CE Planning Support	Vertical	2.2.3
No HDPE-specific financing identified	\$600k co-investment mobilised	Match grants, impact investors, private sector	Investment Leverage	Horizontal	5.2.4
0 MRV protocols for HDPE	Develop 1 HDPE-specific MRV guide	Integrate with national CE indicators	Monitoring & Verification	Horizontal	2.3.3
No community awards	Annual CE Champions Awards launched	Recognise top schools, collectors, SMEs	Recognition Mechanism	Horizontal	2.1.4
No formal HDPE market info systems	Establish 2 info-sharing platforms	Facilitate price and supply transparency	Market Intelligence	Vertical	3.2.3
No certified recycled HDPE outputs	2 products EPA-certified	Support regulatory process and testing	Product Legitimacy	Vertical	3.3.3
No household tracking of HDPE use	2 survey waves conducted	Design and conduct pre-post behaviour surveys	Social Data Generation	Horizontal	2.1.3
No cooperative-level CE indicators	Cooperative CE dashboard piloted	Develop metrics and visualisation tools	Cooperative Strengthening	Vertical	2.2.4
0 shared HDPE processing assets	Deploy 3 shared assets across coops	Develop leasing model and site governance	Shared Infrastructure	Horizontal	3.2.3
No upskilling for extension officers	30 officers trained on HDPE CE	Deliver tailored modules, field practice	Institutional Capacity	Horizontal	2.3.4
No HDPE inclusion index	New inclusion index piloted	Score cooperatives across gender, age, location	CE Equity Metric	Horizontal	2.2.5

Baseline Metric	KPI	Action Required	Broader CE Indicator	Category	TBL Score (Econ. Env.Soc)
No SMS/USSD education campaigns	3 USSD tips campaigns piloted	Partner telcos, CE tip-of-the-day format	Digital Outreach	Horizontal	2.1.3
No circular data logs in place	200 actors use mobile data logs	Train and equip cooperatives and SMEs	CE Data Fluency	Vertical	3.2.3
No HDPE opportunity maps	1 HDPE map generated	Finalise and publish stakeholder-validated map	Evidence for Action	Horizontal	3.2.3
No HDPE packaging EPR traceability	Pilot traceability with 3 producers	Integrate QR/barcode systems and audits	Extended Producer Responsibility	Vertical	3.3.4
No inclusion of youth in processing	≥100 youth engaged in CE hubs	Recruit through NSS, NYEP & CE Labs	Youth Employment	Horizontal	4.2.5
No recycled HDPE product design hub	1 circular product hub operational	Establish in Accra or Kumasi, support SMEs	Circular Design	Vertical	3.3.4
No harmonised sorting protocols	Standardised sorting manual distributed	Train cooperatives and aggregators	Process Standardisation	Horizontal	3.2.3
No HDPE producer incentives	3 manufacturers access tax/CSR benefits	Link to GIPC/ MESTI & Ghana Revenue Authority	CE Incentive Uptake	Vertical	4.3.2
No HDPE industrial return loops	2 closed-loop supply chains piloted	Facilitate B2B exchanges with large users	Reverse Logistics	Horizontal	4.2.3
No CE info at community level	50 community awareness sessions held	Train local ambassadors, use drama and storytelling	Community Engagement	Horizontal	2.2.4
No links with national CE strategy	HDPE roadmap aligned with CE policy	Submit roadmap to MESTI for integration	National Strategy Alignment	Horizontal	2.2.3
No CE governance at MMDA level	10 CE focal points trained and embedded	Identify staff, embed in sanitation/ planning units	Local Governance	Horizontal	2.2.4

Baseline Metric	KPI	Action Required	Broader CE Indicator	Category	TBL Score (Econ. Env.Soc)
No certification scheme for recyclers	1 certification framework designed	Co-develop with EPA, GSA and Plastics Association	CE Quality Assurance	Vertical	3.3.3
No regional coordination platforms	3 Regional Value Chain Forums established	Convene stakeholders quarterly	Multi-Stakeholder Governance	Horizontal	3.3.3
No cultural integration tools	3 HDPE recovery songs or plays produced	Use local music, radio drama for CE awareness	Cultural Integration	Horizontal	1.1.4



Notes:

TBL Scoring uses a 5-point scale per dimension, highlighting relative strength across Economic (E), Environmental (Env), and Social (Soc) contributions.

Vertical KPIs are specific to functions like farming, processing, or cooperative operations.

Horizontal KPIs cut across multiple actors or systems, influencing the ecosystem more broadly.

Many KPIs overlap across steps in the roadmap, especially those associated with pilots and implementation phases.

Data Sources include processor logs, field surveys, cooperative records, and institutional reports.



UNITED NATIONS
INDUSTRIAL DEVELOPMENT ORGANIZATION



Republic of Ghana

About Ghana Circular Economy Centre

The Ghana Circular Economy Centre (GCEC) project supports Ghana's transition to a resource-efficient and inclusive circular economy by promoting innovation, strengthening policy and institutional frameworks, and building capacity across key value chains, including plastics, agriculture and agro-processing (cassava, mango, pineapple and tilapia), and textiles.

The project is implemented by the United Nations Industrial Development Organization (UNIDO) in partnership with the Ministry of Environment, Science and Technology (MEST), with funding support from Global Affairs Canada.

The GCEC serves as a national hub for knowledge generation, stakeholder engagement, and the piloting of circular solutions to advance sustainable industrial development, improve resource efficiency, and create decent jobs.

Host Institution



Value Chain Leads



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