



دائرة الخدمات العامة  
Public Services Department

# Waste Management Strategy

Deliverable

Ras Al Khaimah, UAE, January, 2025



[psd.rak.ae](http://psd.rak.ae)



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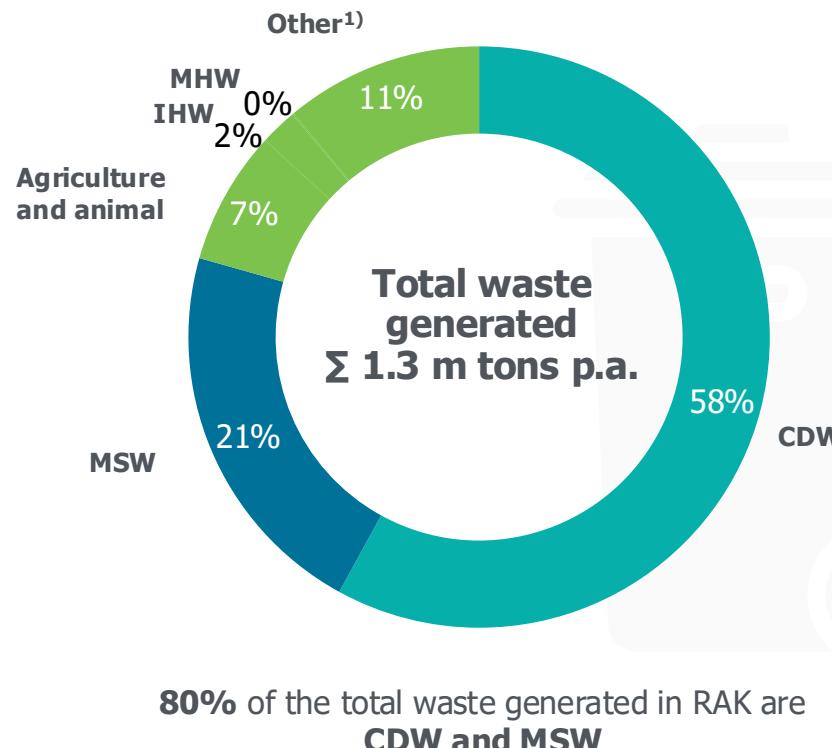
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## **A. Executive summary**

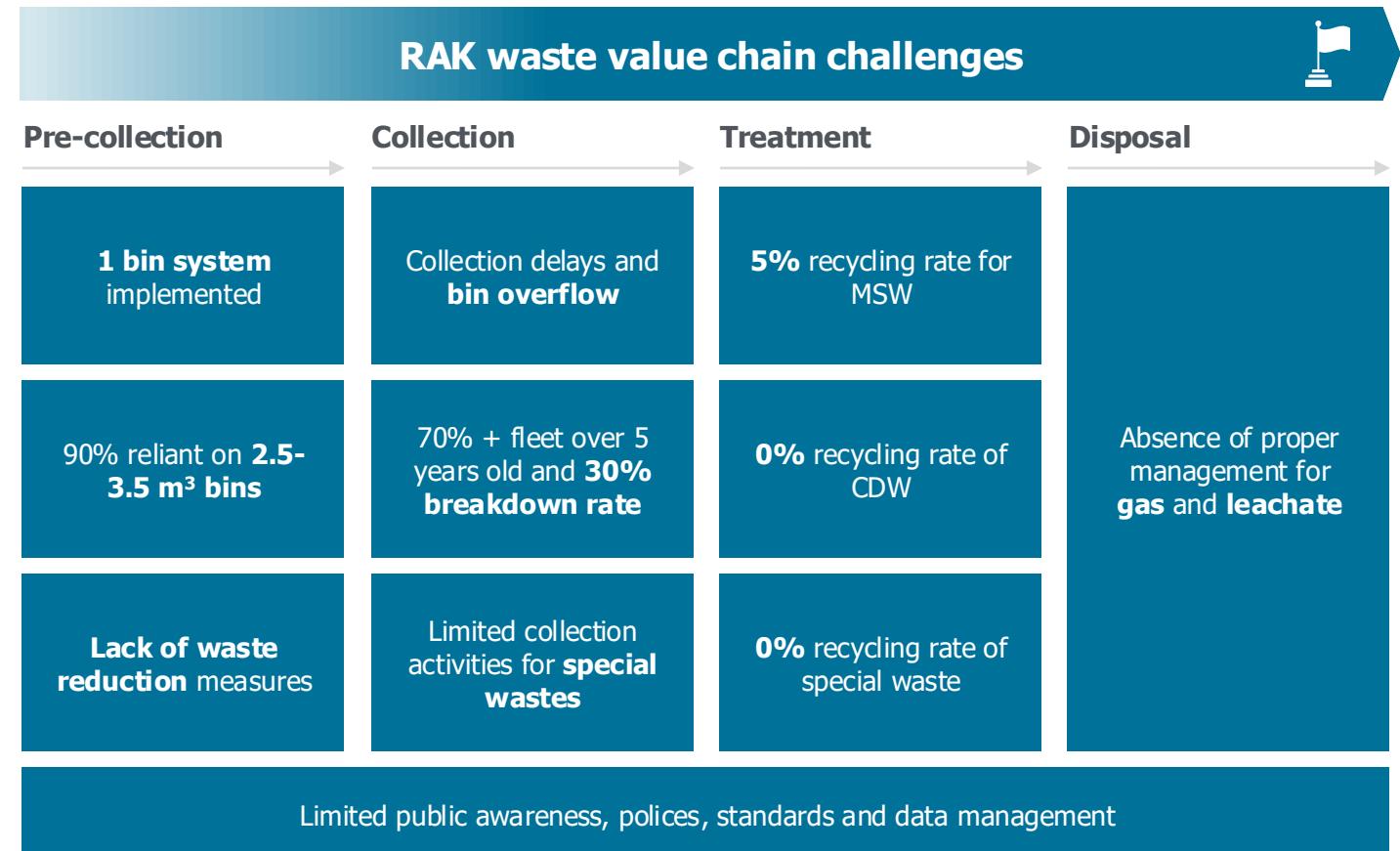
# RAK currently generates ~ 1.3 m tons of waste and faces several key challenges across the waste value chain

## RAK waste management current challenges

### RAK Waste volume generation [%]



1) Main categories include mixed industrial waste, sludge, dust filters, expired products, UCO/ULO, marine waste, tires, etc



# The strategy will focus on delivering a high service level for residents and tourists while generating additional revenues for PSD

VISION

To deliver exceptional waste management services,  
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STRATEGIC PILLARS



**01**

**Make city clean & reduce waste generation of MSW and CDW**

Explore opportunities for waste reduction

Enhance the (pre)-collection service level

Assess opportunities for landfill management



**02**

**Generate revenue from MSW and CDW recycling**

Monetize and recycle Municipal Solid Waste

Improve MRF performance

Develop recycling plan for Construction Demolition Waste



**03**

**Participate in other waste streams to capture profitability**

Develop industrial hazardous waste treatment capabilities

Set-up shredding facility to shred and sell wood waste

Monetize other streams through royalty fees (e.g. UCO) or direct sales (e.g. Tires)

Enablers

Organization & governance

Regulations & standards

Data management

Awareness

Financial transparency

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# The waste reduction plan will focus on technology, awareness, and policy initiatives

## Waste reduction plan

Technology	Policy	Awareness
 <b>WASTE COMPOSTER/DIGESTOR AND COMPACTORS</b>   <b>COMPOSTER</b>   <b>DIGESTER</b>   <b>COMPACTOR</b>  Reduce transportation demand	 <b>Products and materials ban/tax</b> Extend current ban to <b>ban/tax on other single-used plastic product</b>   <b>Sorting at source</b> Implement policy for <b>sorting at the source (2-3-bin system)</b>   <b>Waste fee on commercial</b> Introduce <b>disposal fee on commercial waste generators</b>   <b>Minimum recycled content</b> Impose <b>minimum recycled material use</b> in production, construction, and energy supply   <b>Extended producer responsibility</b> Mandate producers to <b>fund WM activities</b> for their product (being developed at federal level)	 <b>Residents</b> Educate public on <b>impact of waste</b> and waste reduction measures     <b>Hotels</b> Train hotel staff on <b>composting, food planning</b> , and promote waste reduction to tourists     <b>Students</b> Foster sustainable, <b>waste limitation mindset</b> among youth     <b>Construction</b> Educate <b>importance of sorting at source</b> and promote usage of <b>recycled aggregates</b>  

# Decentralized composters/digesters reduce transport costs and improve landfill diversion, with single-property installations preferred for simplicity

## Decentralized composter/digester implementation strategy

### Decentralized composter/digester initiative

- PSD should target high-end/ large hotel for composter/digester implementation due to high potential of food waste generation



### Implementation cost



### Benefit/cost

#### PSD

- Transportation cost reduction
- Higher landfill diversion
- Emission reduction from organic waste in landfill

#### Hotel

- Waste mgmt. fee reduction
- Brand image improvement

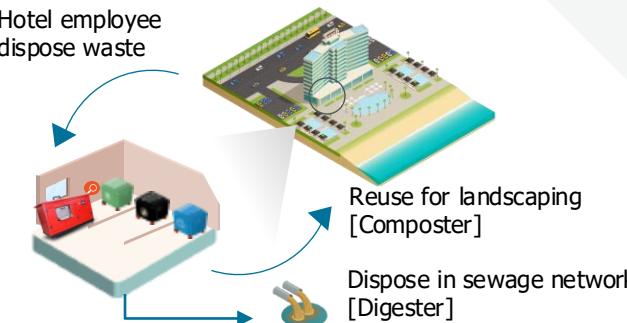
#### Cost

- Inspection and enforcement
- Awareness and education

Cost of the machine will be **borne by the hotel**, which will be responsible for its **procurement and installation**

### Operating model selection

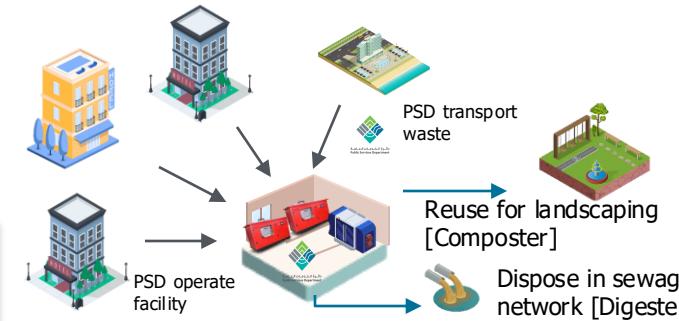
#### Single property onsite



- PSD enforce the installation of composter/digester
- Hotel operate machines on their own
- Limited operational complexity for PSD

#### Preferred option

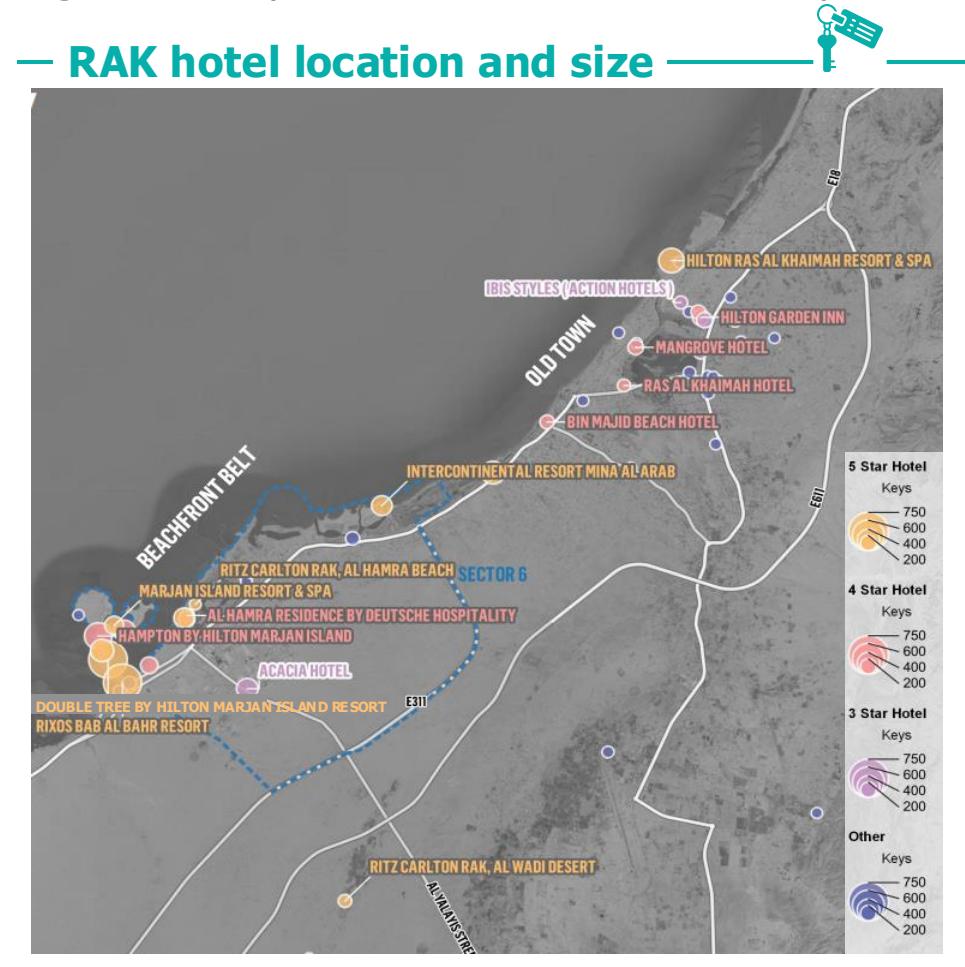
#### Shared composter/digester



- PSD to install and establish composting/digesting station
- PSD to transport organic waste from hotels
- PSD to operate and maintain station

# Digester/composter initiative can be piloted in large 4-5 star hotels during Q1/Q2 2026 and later expanded to medium-sized hotels

## Digester/composter initiative enforcement plan



2025



**Regulatory framework and guidelines** outlining the requirements for installing digesters and composters



**Incentive mechanisms** to encourage the participation (e.g., Green Hotel Certificate, financial incentive, Tax reduction)

2026

Q1

Q2

Q3

Q4

### Initial rollout

Collaborate with **luxury hotels (4-5 stars)** with the **highest key counts** to install digesters or composters

- Plan and rollout initiative
- Identify suitable suppliers



Monitoring the **performance** of the initiative's pilot phase

Conducting **ongoing awareness and training sessions** to support the installation and operation of machines in hotels

### Expand installation

Expand efforts to **medium size hotels (3-4 stars)** to complete initiative

- Collaborate and educate hotel



Monitoring the **compliance** of initiative

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# A 2-bin system aligns with RAK's waste strategy, while a 3-bin system can be targeted at hotels to effectively reduce food waste

## Bin system comparison

	1-BIN SYSTEM	2-BIN SYSTEM	3-BIN SYSTEM
Infrastructure alignment	 Low recovery rates, reducing MRF potential and recyclables sales	 Aligned with MRF/RDF infrastructure	 Requires the set-up of composting plants – but can be deployed in hotels
Off-Take market availability	 No separation, fewer recyclables sold	 Market available for recyclables and RDF	 Limited market for compost in RAK – but hotels can dispose organics in on site digestors
Cost consideration	 Lowest cost, simple collection	 Moderate cost, manageable collection frequency	 High cost due to daily collection of organics
Awareness	 Minimal awareness needed	 Requires moderate awareness, achievable	 Requires extensive awareness campaigns

*Awareness needed to bridge current gap*

**RECOMMENDED**

**FOR HOTELS**

**Waste sorting and segregating requirement will be included in the comprehensive waste management standard to guide developers and waste generators**



# A two-bin system is recommended for private villas/communities to segregate recyclables and improve recycling rate

Sorting at source – villas/communities (commercial segment)

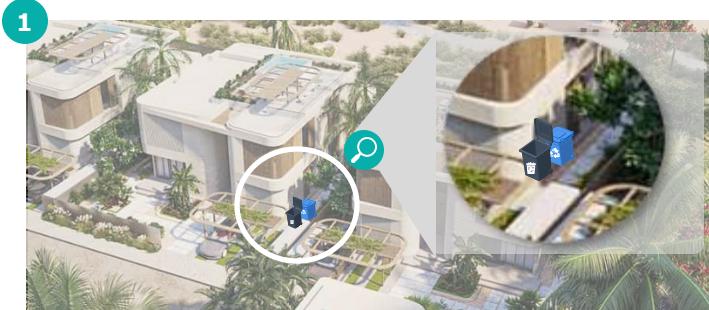


Waste sorting and segregation guidelines will be included in the waste management standard document



## System design and specs

Bins deployed in communities and placed inside<sup>1)</sup> properties



Bin taken out on collection day at the specified collection time and returned after collection



1



Collection frequency  
3-4 times per week



Minimum weekly

## Standardized color codes of bins and bags



General

Recyclables

## Example of bin sizes



60 L bin



120 L bin



240 L bin

+

## Labels and educational instructions



RFID tags on bins to enable data collection



On each bin, showing material types

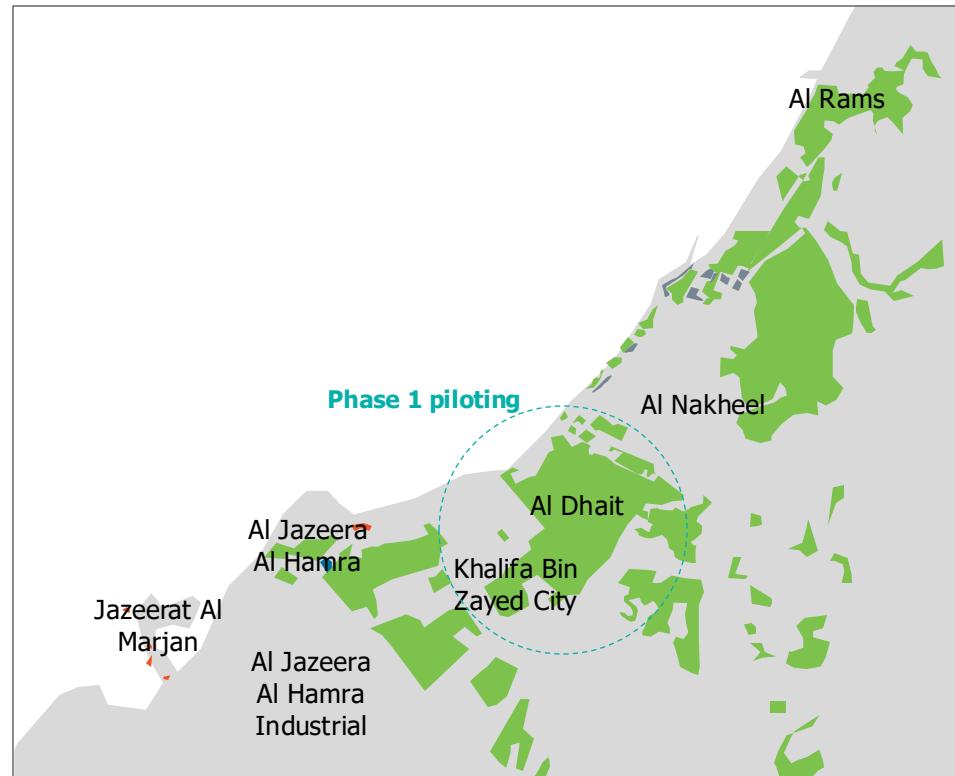
## Key consideration

- PSD will oversee the procurement and deployment of bins
- PSD will establish waste collection contracts with master developers and charge them for the services provided
- A structured collection schedule will be implemented, requiring residents to place bins outside for collection and return them afterward

1) In case of capacity constraint inside the property, bins can potentially be placed outside as well

# Transitioning to a 2-bin system will be done in phases, with proper monitoring and awareness efforts

## Residential 2-bin system implementation detailing



### 2027/2028 – Phase 1 piloting

- Pilot zone **size 10-20% of total residential villas** (4,000-10,000 villas)
- For example, select zones like Al Dhait and Khalifa bin Zayed city

Continuous **awareness campaign** and **segregation rate monitoring**

### 2029/2030 – Phase 2 full scale implementation

- Based on lessons learned, gradually expand system implementation area
- 2028-2029:** roll out to **50% of residential area**
- 2029-2030:** complete transition for **all areas**

### Phase 1 pilot KPIs

Are residents actually using the 2-bin system?

- KPI to track: **participation rate** of 2 bin system (%)

Are residents placing the correct material in the right bin?

- Contamination rate** of dry mixed recyclable bin (%)

**High level CAPEX estimation for bin deployment**

**AED ~25-30 m**

# A two-stream waste chuting system, supported by digital technology, can be incorporated into new high-rise buildings to enhance recycling rates

## Sorting at source – high rise buildings



Waste sorting and segregation guidelines will be included in the waste management standard document

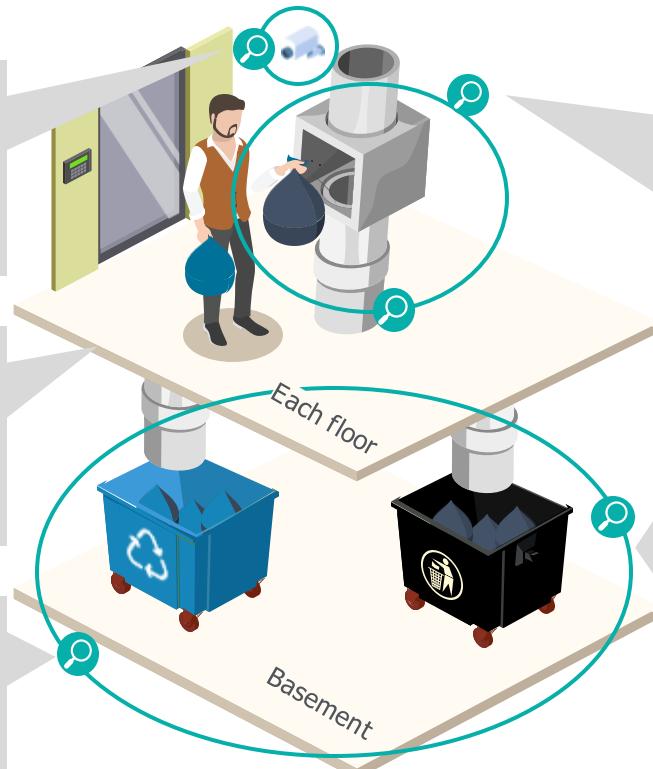


### System design and specs

#### Digital technology to track the compliance



Chute access rooms monitored to capture illegal access, wrong placement of bags and contamination



#### Instructions on chute access door or in chute room



#### Types of bins beneath chutes



720 L or 940 L bin

#### Single inlet with button to select waste type

Can alternatively be a chute with 2 inlets for the 2 different waste streams



#### Standardized color codes of bins and bags



### Key consideration

- PSD will collaborate with RAK Municipality to incorporate a two-stream waste chuting system into the building code, ensuring developers implement this system in new high-rise buildings
- CCTV camera can be implemented to ensure the residents compliance
- Collection contract will be signed with building management with tailored collection schedule

# A two-bin system can be deployed in public spaces to promote waste segregation and improve recycling rate

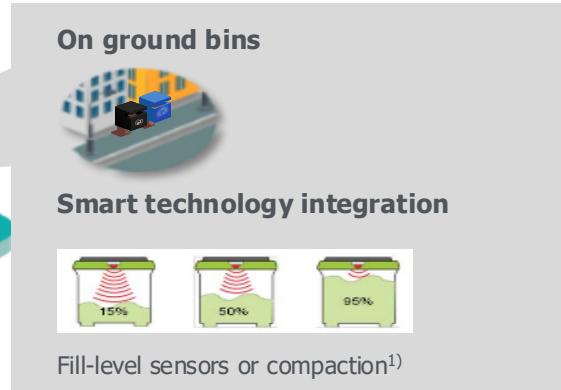
Sorting at source – public spaces



Waste sorting and segregation guidelines will be included in the waste management standard document



## System design and specs



## Compliance

Primary solution is awareness, and clear messaging



On each bin, showing material types

A "waste nudge" uses subtle interventions to encourage sustainable waste behaviors without mandates

## Key consideration

- Implement a two-bin system to emphasize the importance of recycling in the public spaces
- Consider fill-level sensors, compaction, underground bins, and awareness-focused nudging designs to ensure public compliance, raise awareness, and maintain the city's cleanliness

# A three-bin system associating with compactor and composter is ideal for hotels in RAK to enhance recycling efforts and reduce organic waste

## Sorting at source – hotels



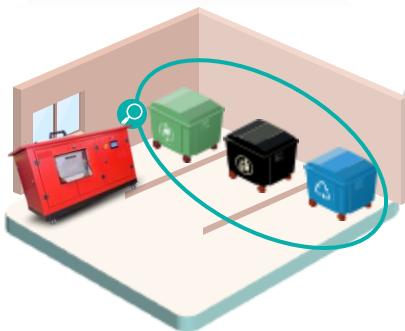
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### System design and specs

#### Waste storage rooms

Inside (ground floor or basement) or in a closed room next to the building



#### Standardized color codes of bins and bags



#### Collection frequency

- Directly treated on site by waste digestors
- Minimum weekly
- Based on demand of the hotel

#### Stainless steel skip for general waste and 1,100-4,500 L bin for recyclables, and smaller plastic bin for organic waste



On each bin, showing material types

#### Waste composter/ digester

On-site composter or digester to directly process organic waste collected from organic bins



#### Waste Compactor

General waste and recyclable bins can be bought/replaced by waste compactor to reduce collection cost

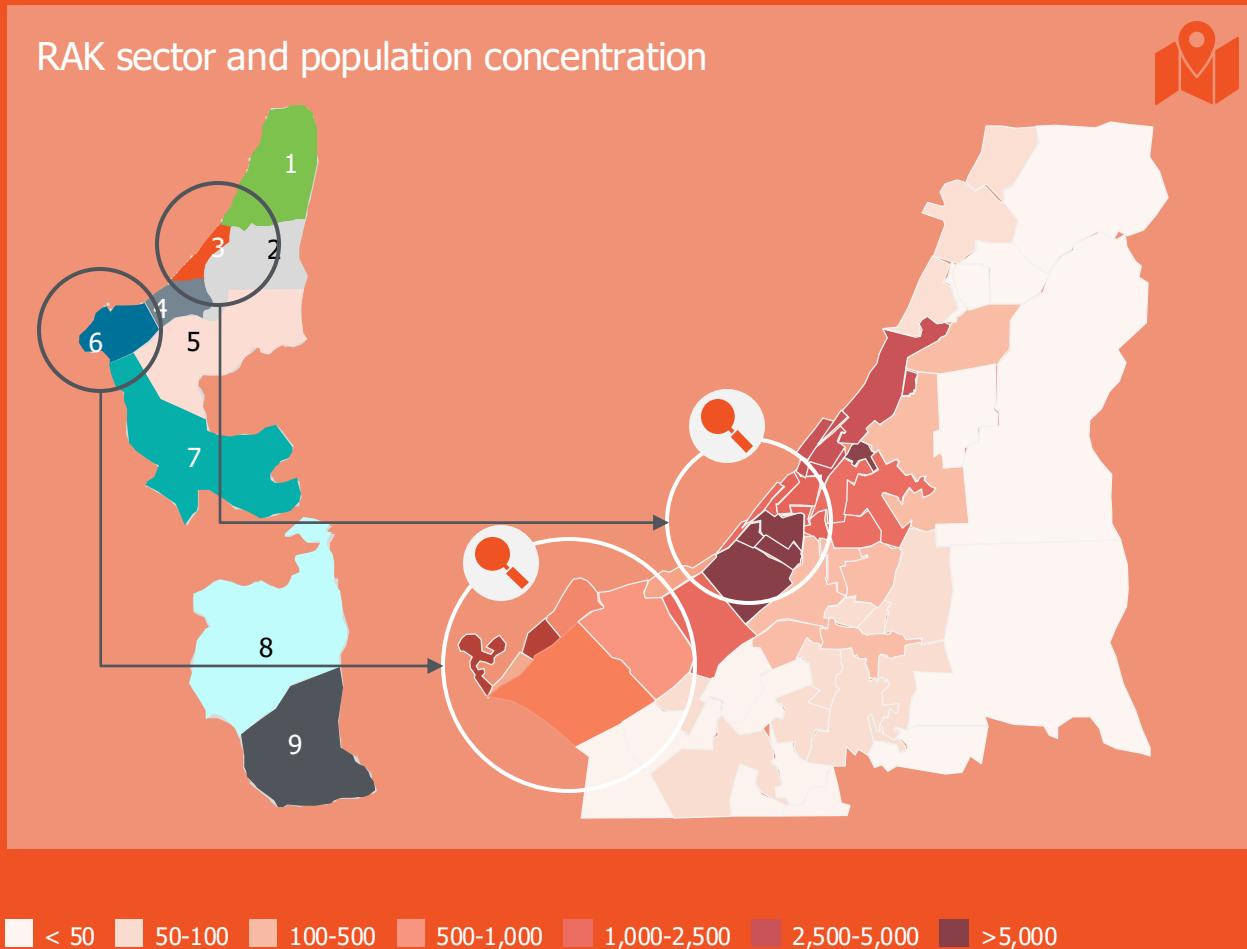


### Key consideration

- Given the high volume of food waste, a three-bin system will be implemented to facilitate recycling and reduce organic waste
- Organic waste will be treated onsite using decentralized composting or digesting machines, rather than being collected
- PSD will rent out bins while requiring hotels to purchase waste digester/ compactor machines

# In order to further boost recycling, we propose the piloting of collection centers and RVMs starting in high-density areas

## Collection of recyclables



In high population concentration areas of **sector 3 and 6**, to improve **recycling and generate revenue**, we can pilot:

### Collection center



### Reverse vending machine



### Ideal piloting location should have features of:



High traffic



High frequency of visits

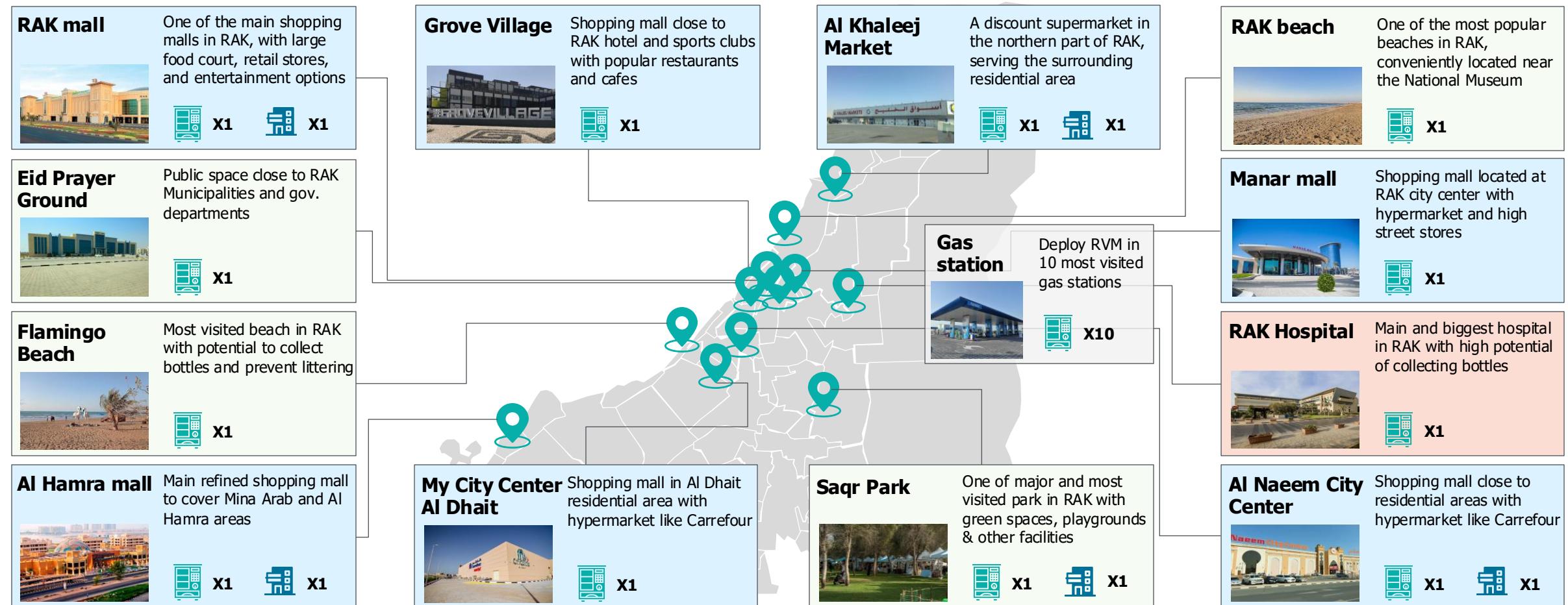


Convenient



# RVMs and collection centers should be strategically placed in high-traffic areas such as malls, popular public spaces, and hospitals to maximize participation

Potential location for RVM and collection center



RVM



Collection center



Shopping malls/market



Public spaces



Hospital

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Enablers

Organization & governance

Regulations & standards

Data management

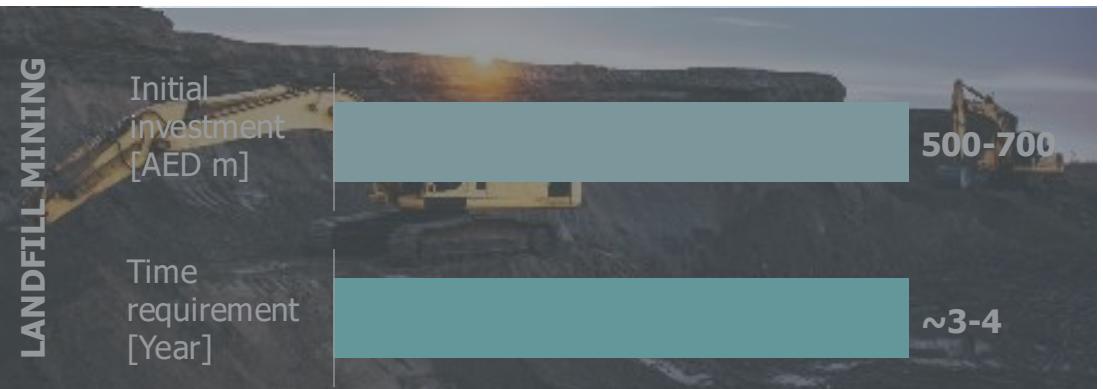
Awareness

Financial transparency

# Comparison between capping and mining suggests that landfill capping is a more cost-effective and faster option for implementation

## Landfill management

### Landfill capping as the ideal solution

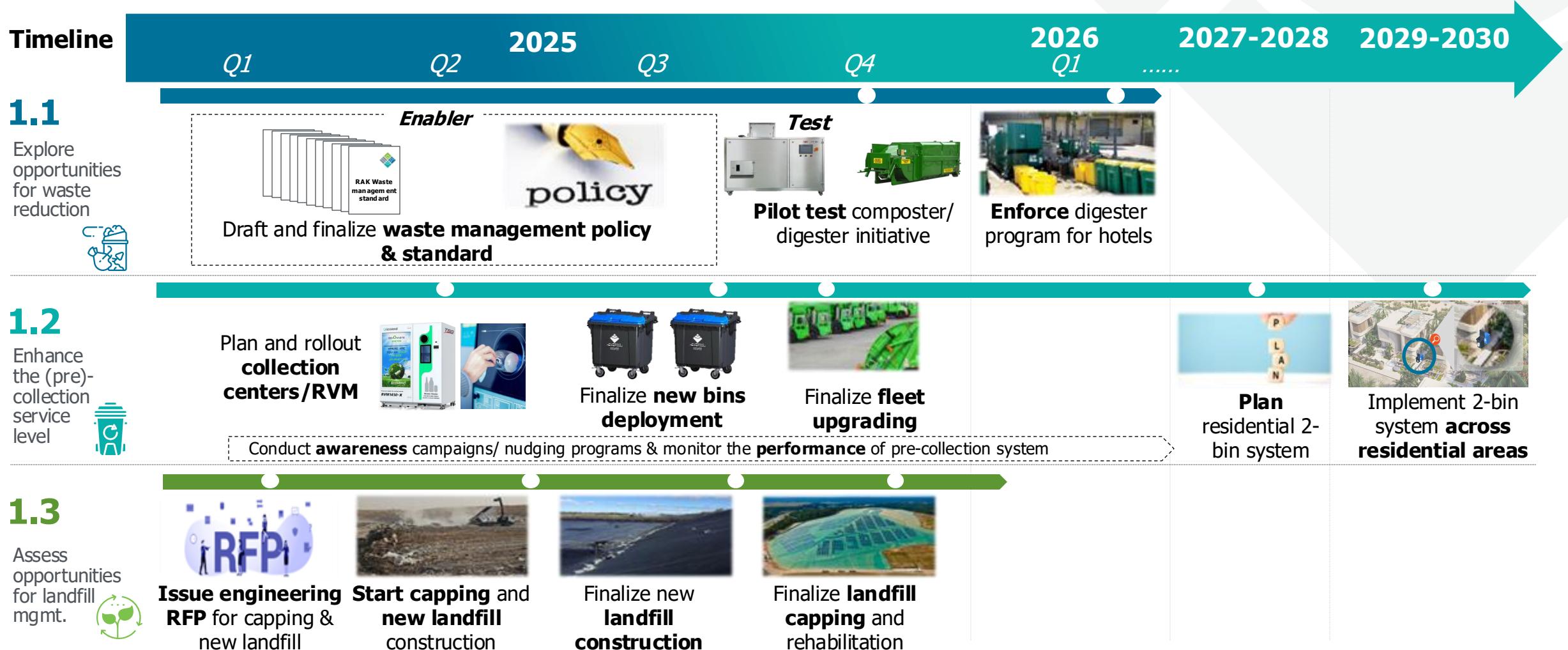


### Key next steps for landfill capping

Key next steps for landfill capping	EXPECTED TIMELINE
1 Develop and issue RFP for <b>landfill closure engineering firm</b>	Q1 2025
2 Collaborate with selected engineering consultant to <b>finalize capping design</b>	Q1- Q2 2025
3 Develop and issue RFP for <b>landfill capping contractor</b>	Q1-Q2 2025
4 Oversee and <b>monitor the landfill capping</b> work	Q2 2025 – Q4 2025
5 Develop and issue RFP for landscaping / reusing (solar farm) <b>design and work</b>	Q3 2025
6 Oversee and <b>monitor the</b> landscaping / reusing (solar farm) work	Q4 2025

# Next steps for the first strategic pillar include finalizing standards/policies, enforcing composters, upgrading bins and fleet, and capping the landfill

Implementation roadmap - 1. Make city clean & reduce waste generation of MSW and CDW



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# A semi-automated MRF balances investment, operational costs, and recovery rates, making it the most suitable option for the current state

## MRF upgrades

### We propose to upgrade MRF with:



Expansion of capacity by adding a new line of 170 k tons p.a. to maximize utilization of MSW



Automation to improve recycling recovery rate from 5% to 10%



Relocation of existing 110 k tons line to new landfill to minimize operational cost



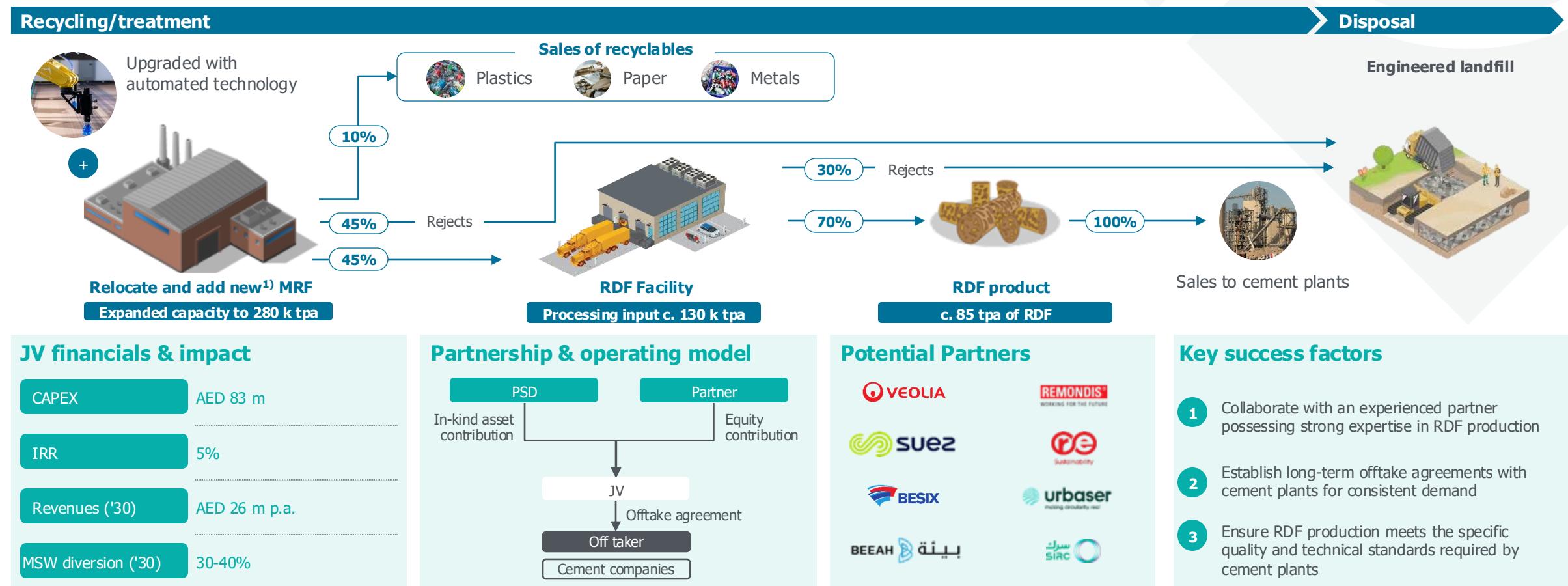
### MRF UPGRADING COMPARISON

MRF TYPE	Manual MRF	Semi-automated MRF	Fully-automated MRF
TECH	MANUAL SORTING AND PICKING	AUTO SORTING MANUAL PICKING	AUTO SORTING AUTO PICKING
CAPEX	LOWEST INVESTMENT	MODERATE INVESTMENT	HIGHER INVESTMENT
OPEX	HIGH OPEX	MODERATE OPEX	LOW OPEX
UPTAKE	LOW RECOVERY RATE	HIGH RECOVERY RATE	HIGH RECOVERY RATE
FES.	FEASIBLE	FEASIBLE	NOT FEASIBLE AT THIS STAGE TO BE DEVELOPED WHEN SORTING AT SOURCE IMPROVES

FAVORABLE UNFAVORABLE UNFAVORABLE

# Establishment of a new MRF and RDF plant will generate 26 m AED in additional revenue, requiring an investment of 83 m AED to be executed through a JV

## New MRF line and RDF plant overview



1) new line has capacity of 170 k tons p.a.

xx% % of waste volume processed in the previous treatment step

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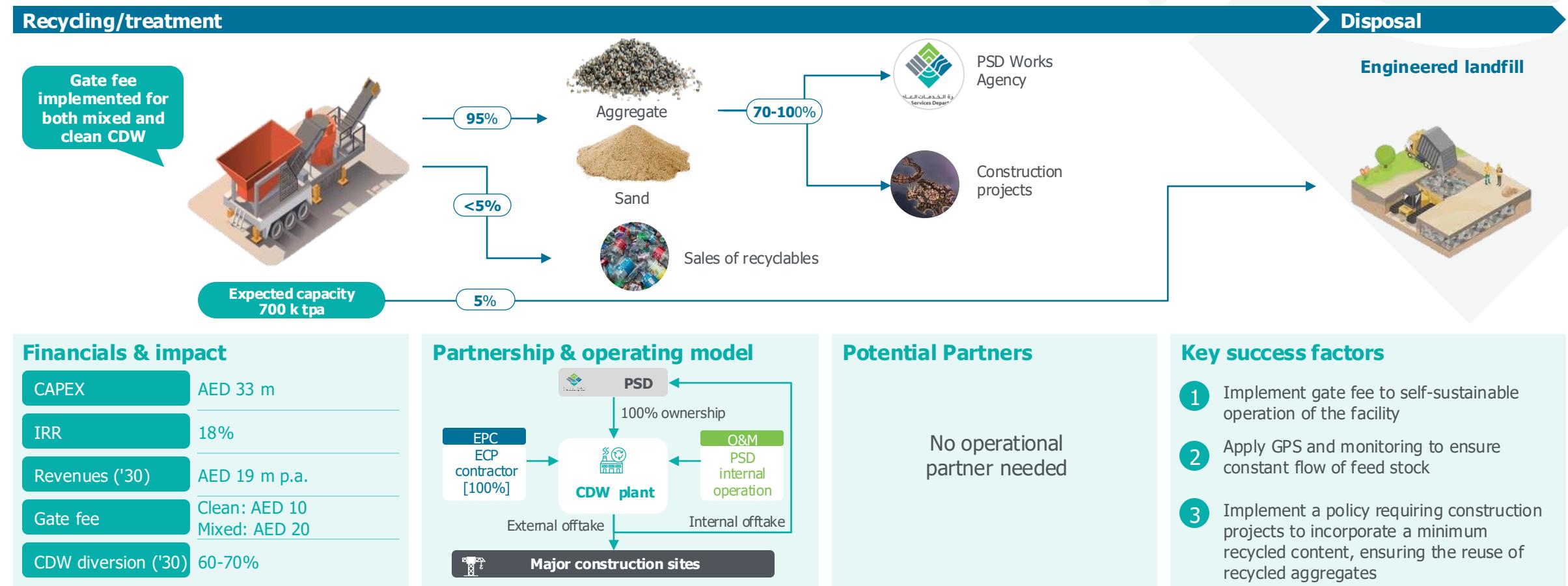
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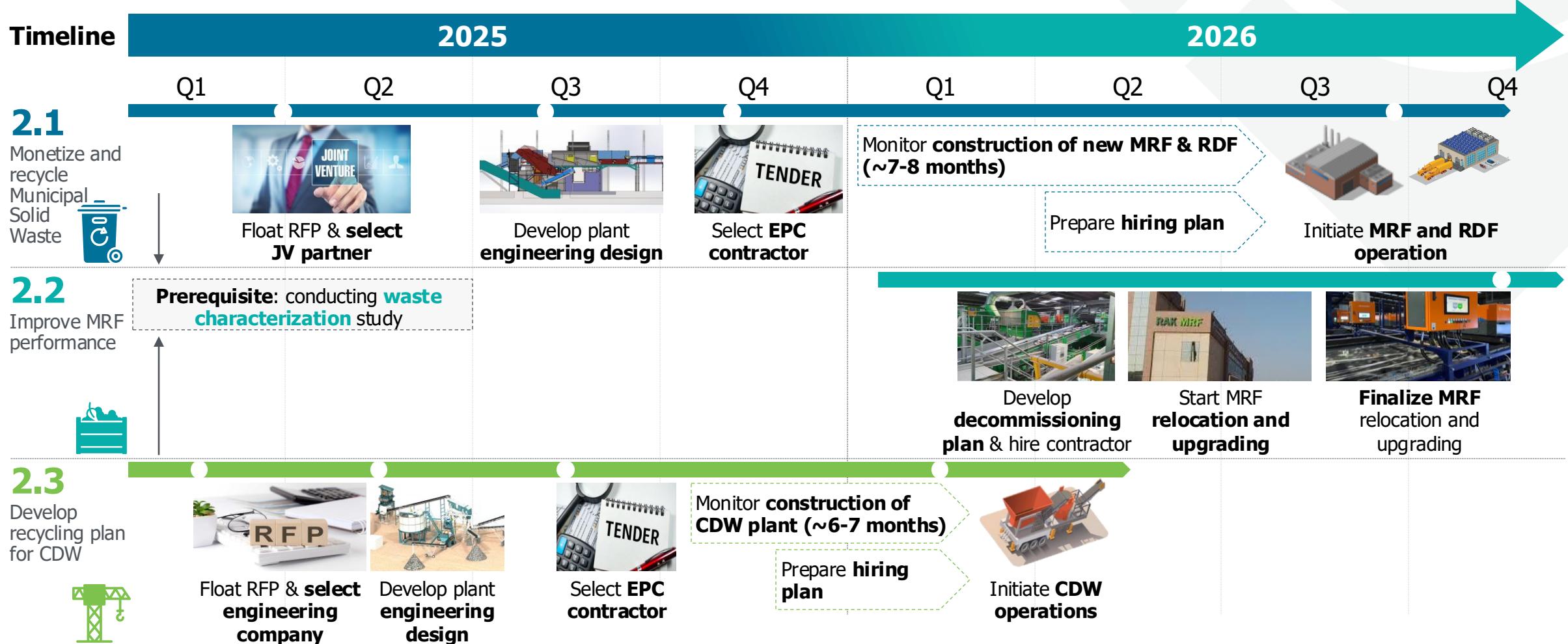
# A fixed CDW facility with a capacity of ~ 700 k tons per year can be established in RAK to generate potential revenue of AED 19 m

## CDW recycling plant overview



# New MRF and RDF operations are set to commence in Q4 2026, with CDW operations beginning in Q1 2026

Implementation roadmap - 2. Generate revenue from MSW and CDW recycling



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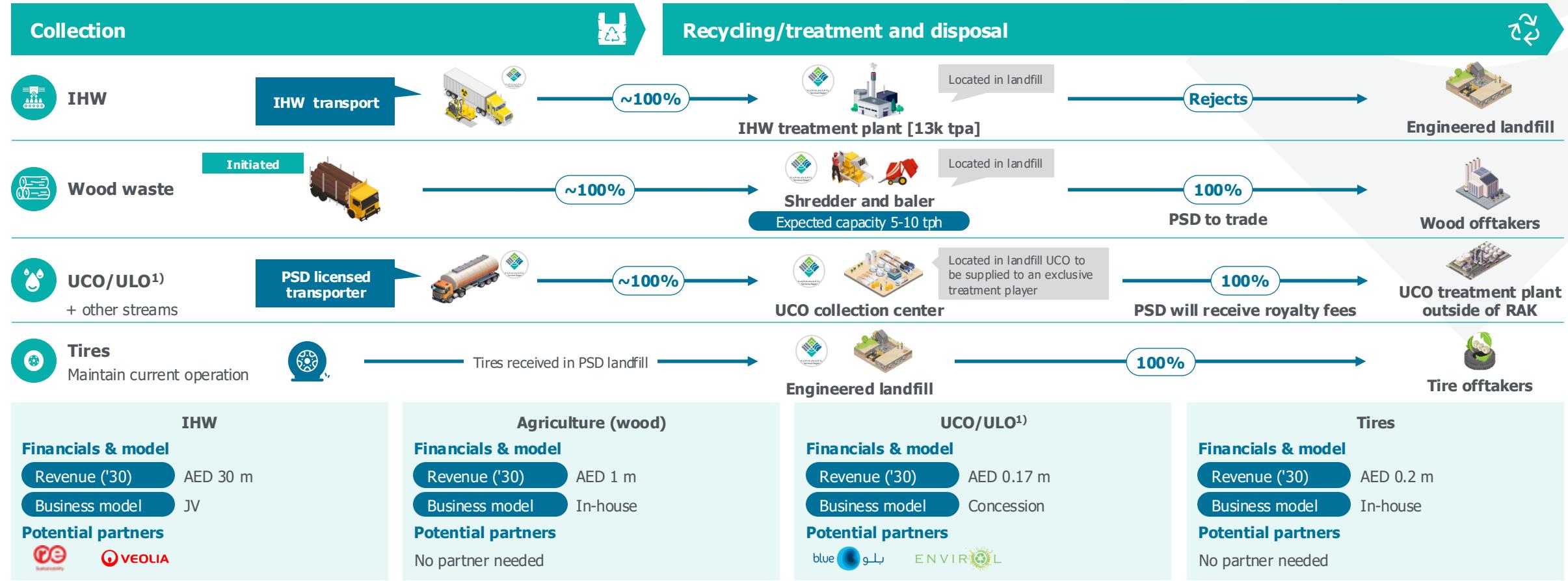
Regulations & standards

Awareness

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# IHW will be processed at a treatment facility, wood and tires will be sold, and used cooking oil will be sent to a treatment plant

## Other waste streams overview

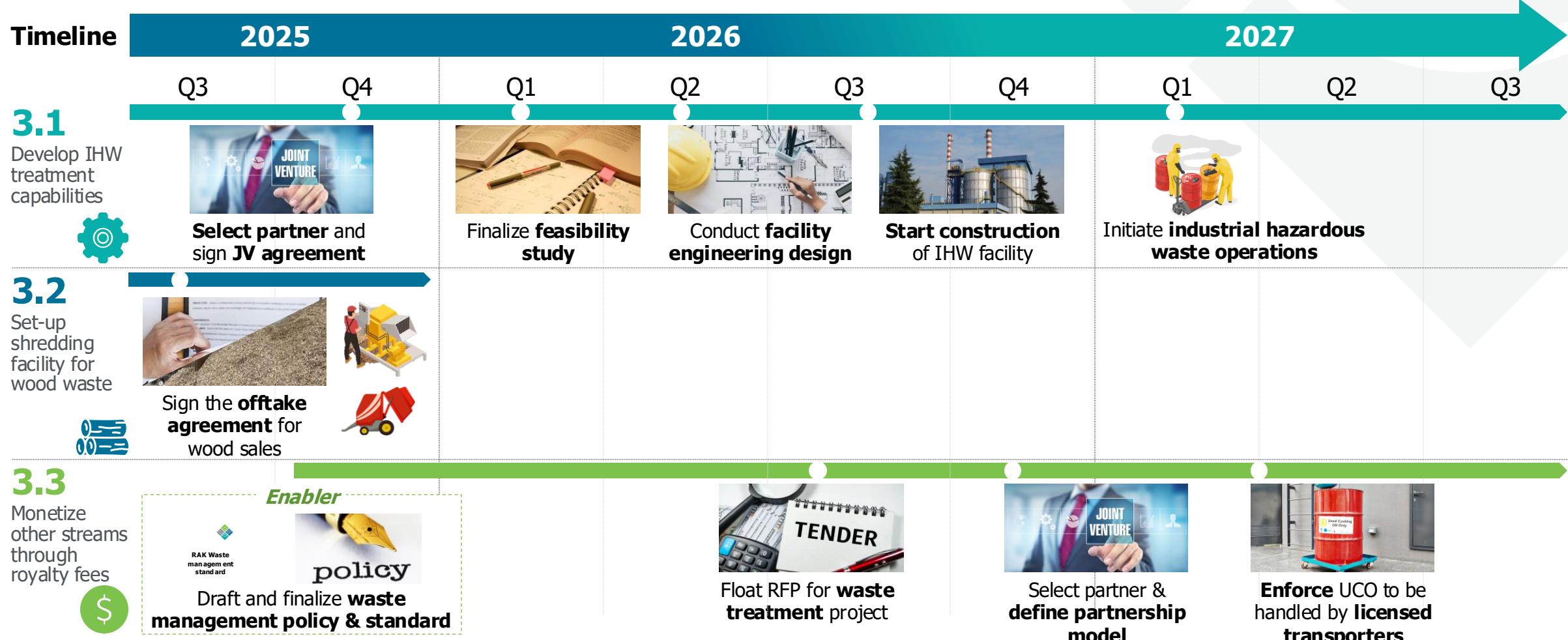


**Given the small quantities and infrastructure needs, PSD should adopt a waste management licensing and royalty-sharing model to formalize the sector and generate revenue**

1) Only consider UCO at current stage, ULO to be further explore as the UCO business ramp up

# The initiatives for engaging in other waste streams are expected to begin in late 2025 and continue into 2026 and 2027

Implementation roadmap - 3. Participate in other waste streams to capture profitability



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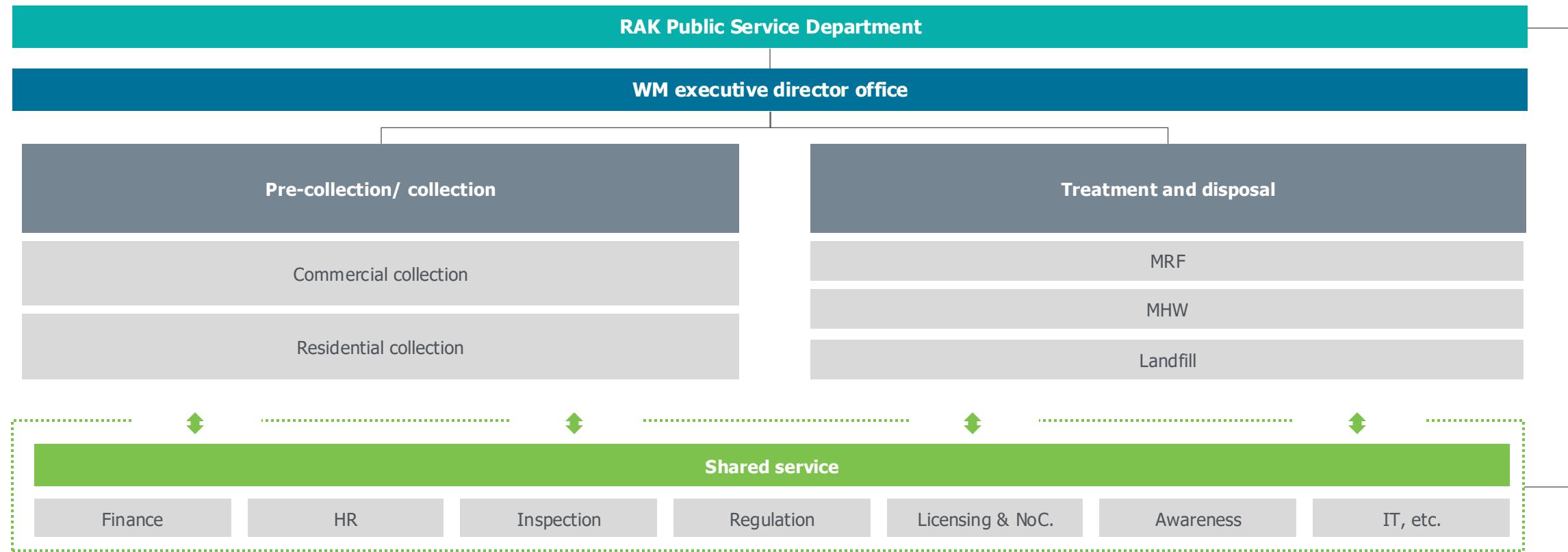
Data management

Awareness

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# WMA can be structured by the waste value chain and streams, with each sub-department/BU maintaining its own WM and financial reports for accountability

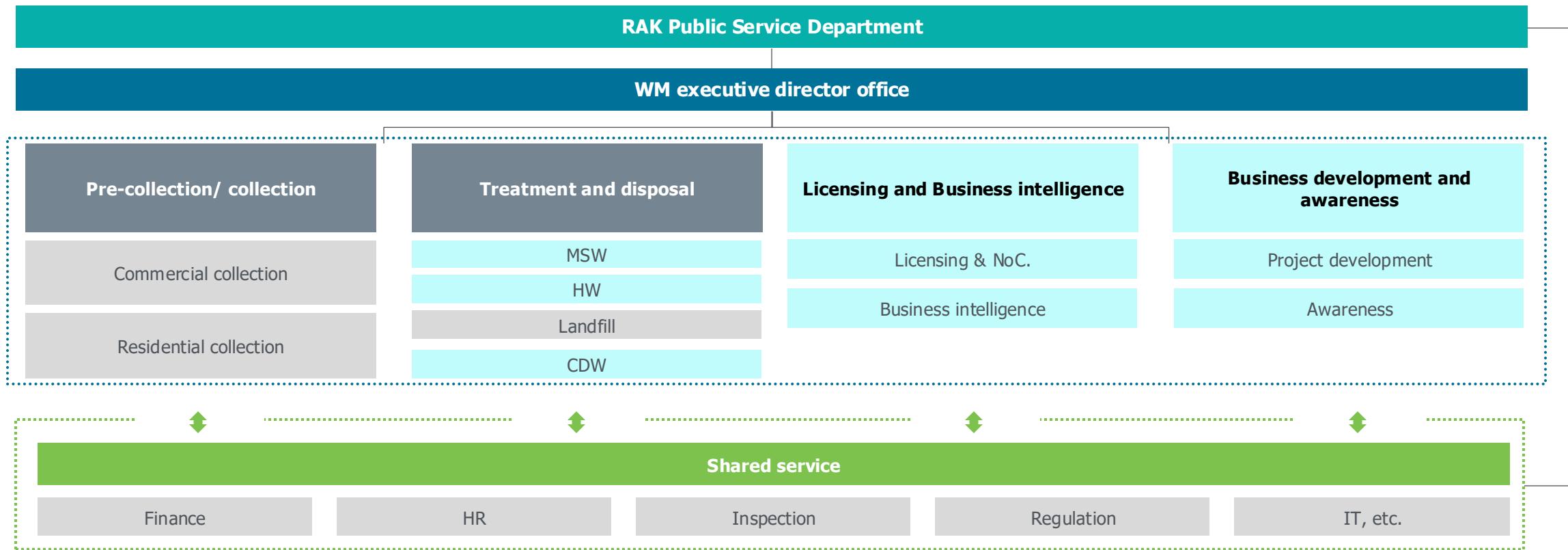
Overview of Waste Management Agency organizational structure – [Current state]



Shared service at PSD level

# The revised structure introduces two new business units and strengthen the existing treatment unit

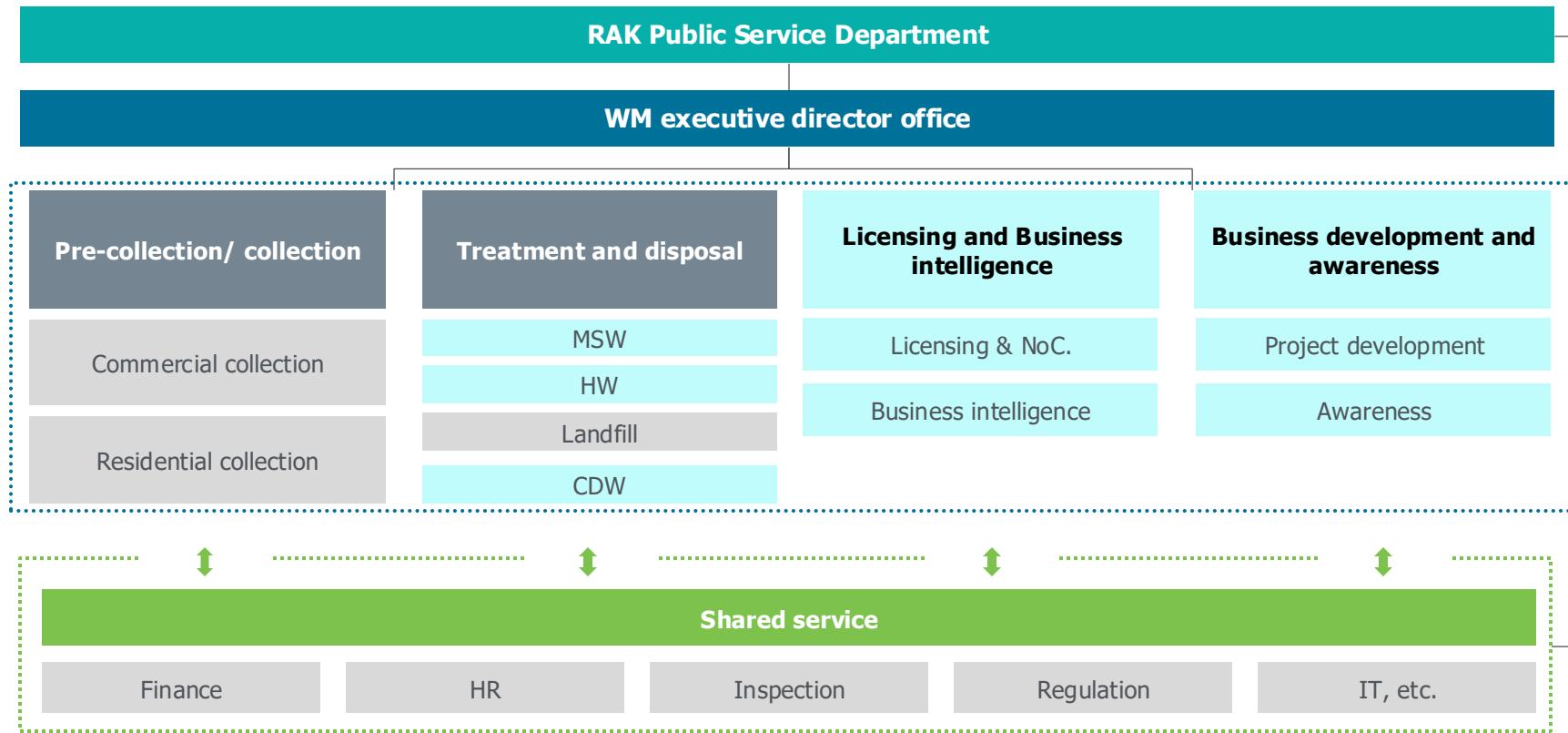
Overview of Waste Management Agency organizational structure – [Proposed state]



Shared service at PSD level Now or modified departments

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Overview of Waste Management Agency organizational structure – [Proposed state]



## Key benefit

- Clear accountability
- High specialization
- Improved financial transparency
- Cost synergies from shared services

Shared service at PSD level Now or modified departments

# PSD should develop standalone P&L, balance sheet, and cash flow statements for each business line to track financial performance independently

Proposed financial reporting structure

## Current state:

**Lack of segregation in financial reporting**



- Financial reports are consolidated without standalone P&L, balance sheets, or cash flow statements for individual business lines (e.g., MRF, CDW, collection)
- Limited visibility into the financial performance of each business line, hindering decision-making and profitability analysis.

## Implement business line-specific financial reporting



RDF



CDW



MRF



MHW

...

- Develop standalone P&L, balance sheet, and cash flow statements for each business line to track financial performance independently
- Standardize reporting processes across all business lines to ensure consistency and comparability

# To support the strategy, an awareness program should be directed at four key segments

## Awareness overview

### EXAMPLE OF KPIS



### Residents

Inform and encourage residents to adopt sustainable behaviors and sorting practices

- % of target audience reached
- # tons of recyclable collected per community
- # tons of food waste donated



### Hotels

Train hotels on the sorting system and food planning to promote source separation and reduce food waste

- # tons of organic waste treated onsite
- % reduction in food waste from hotels



### Students

Instills knowledge about environmental challenges and sustainable practices from a young age

- # of workshop /curriculum delivered
- % participation rate of schools
- Student and parent awareness & behavior change



### Construction

Raise awareness about the importance and mandatory compliance of on-site sorting at construction sites

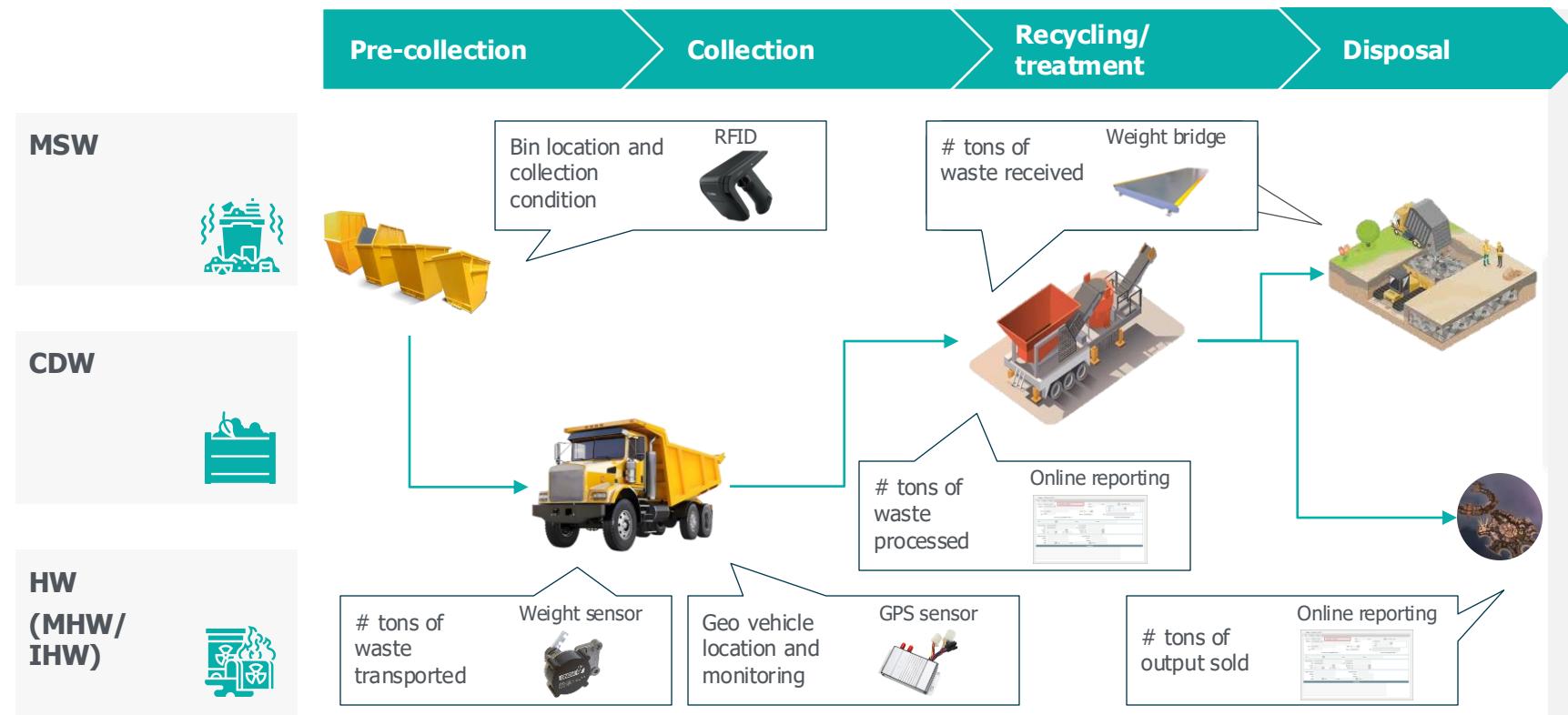
- % of clean CDW received
- # of site visit conducted
- % of construction site compliant with sorting at source

# An e-manifest and centralized platform can assist PSD in monitoring RAK's waste flow while providing valuable insights through data analysis

Overview of E-manifest system and centralized data management platform

## FOCUSED WASTE STREAM

### WASTE VALUE CHAIN DATA COLLECTION



PSD will fund the platform development and hardware for its fleet, while CDW generators will be responsible for hardware upgrades, including GPS installation

### CENTRALIZED DATA MGMT. PLATFORM

#### WM dashboard

- Waste generation
- Collection rate
- Illegal dumping
- ....

#### Vehicle tracking

- Vehicle location
- Illegal dumping monitoring
- Route optimization
- ...



Single source of truth



Inspection and enforcement enablement



Insight generation across streams and value chain

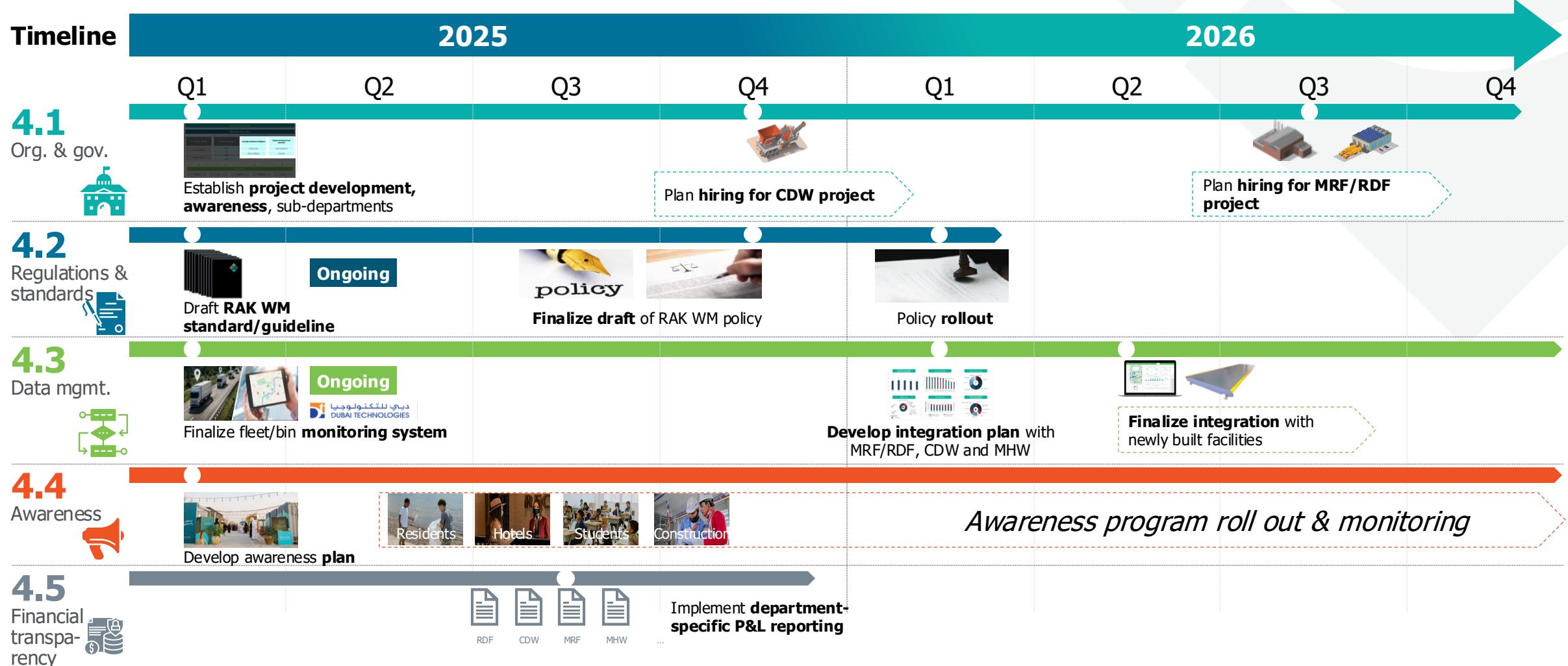
# To support strategy implementation and success, we prioritized and recommended developing 8 policies and 1 comprehensive standard document

Suggested waste management policies and standards

Priority policies and standards to be launched to support the strategy execution	
<p><b>Key objectives</b></p> <ul style="list-style-type: none"><li>1 Waste reduction</li><li>2 Secure off take market</li><li>3 Ensure waste flow control</li></ul> <p><b>Current state</b></p> <ul style="list-style-type: none"><li>! Absence of a waste management policy outlining compliance requirements</li><li>! No waste management guidelines exist to guide external stakeholders</li></ul>	<p><b>RECOMMENDED PRIORITY POLICIES</b></p> <ul style="list-style-type: none"><li> <b>Products and materials ban/tax</b></li><li> <b>Waste fee on commercial segment</b></li><li> <b>Sorting at the source</b></li><li> <b>Minimum recycled content</b></li><li> <b>Extended producer responsibility (EPR)</b> <i>Being developed at federal level</i></li><li> <b>Fines for non-compliance/illegal activities</b></li><li> <b>WM license/permit/NoC requirement</b></li><li> <b>E-manifest (waste management digital system)</b></li></ul>
	<p><b>TECHNICAL WASTE MANAGEMENT STANDARDS</b></p> <p><b>RAS AL KHAIMAH WASTE MANAGEMENT GUIDELINE</b></p> <p></p> <p>Section 1 MSW</p> <ol style="list-style-type: none"><li>1. Target groups</li><li>2. Source segregation, bin systems, and waste streams</li><li>3. Waste and recycling storage systems and requirements</li><li>4. Waste collection requirement</li><li>5. ....</li></ol> <p>Section 2 CDW</p> <ol style="list-style-type: none"><li>1. Scope and target audience</li><li>2. Requirements for Obtaining NOCs</li><li>3. Material classification</li><li>4. Waste producers and source segregation</li><li>5. Collection and transport</li><li>6. Treatment</li><li>7. Inspection and fines</li><li>8. ....</li></ol> <p></p>

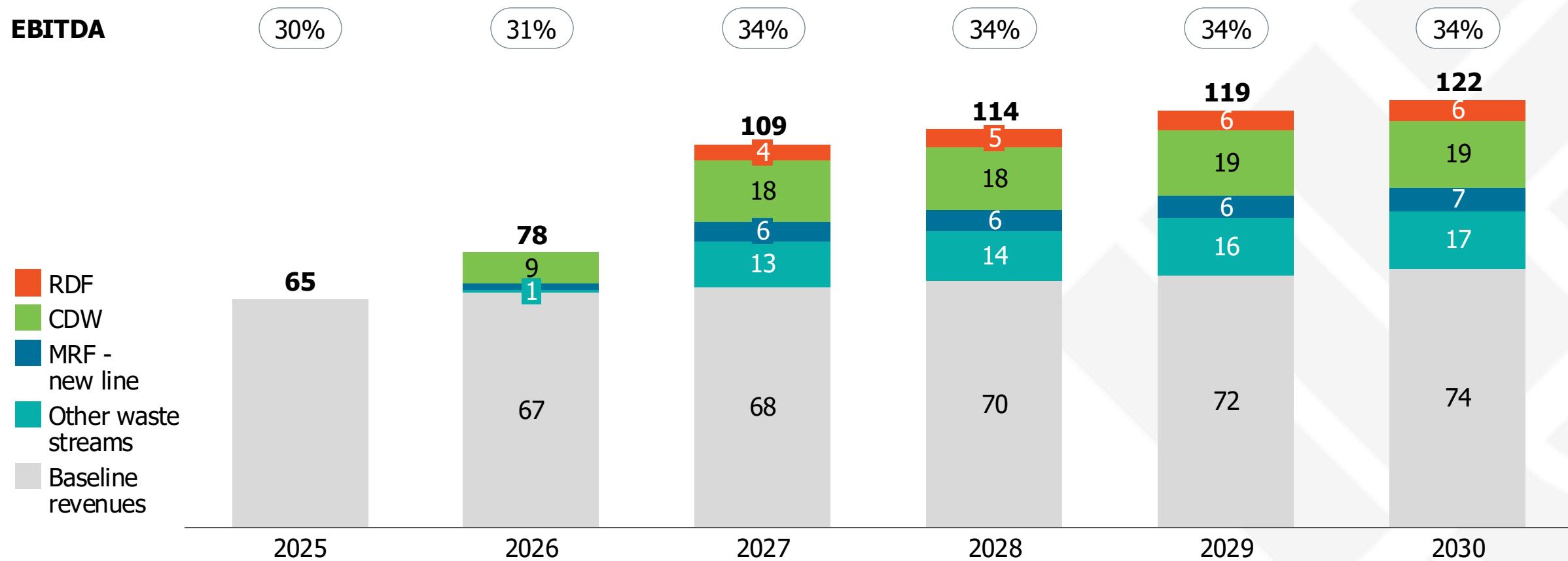
# Enablers will be implemented over 2 years, prioritizing organizational structures and regulations, with others dependent on operational initiatives

## Implementation roadmap - Enablers



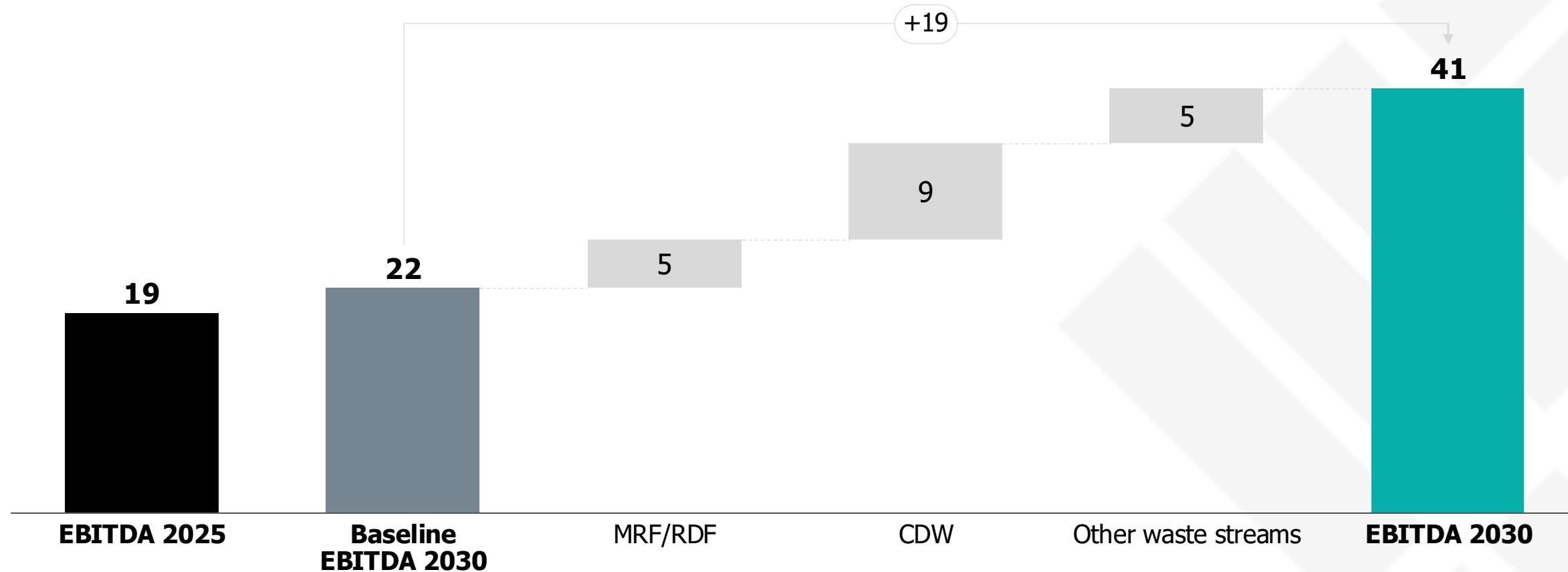
**With the implementation of new strategy, PSD will be able to reach revenues of ~AED 120 m with the EBITDA margin of 34% in 2030**

Revenue evolution – PSD WM department



**Compared to the 2030 baseline, EBITDA is expected to increase by AED ~20 m reaching ~AED 40 m**

EBITDA evolution – PSD WM department



# The strategy will require a cumulative investment of ~AED 286 m to be deployed over the next years

Overview of investment required

		Project investment	PSD required investment	CAPEX injection year		
	<b>Refuse-derived fuel (RDF)</b>		AED 20 m	AED 10 m <sup>1)</sup>	2025	Investment in facility civils works, RDF required equipment purchase and vehicles
	<b>Construction and Demolition Waste (CDW)</b>		AED 33 m	AED 33 m	2025	Investment in CDW fixed facility civils works, required equipment purchase and vehicles
	<b>Materials Recovery Facility (MRF)</b>		AED 64 m	AED 32 m <sup>1)</sup>	2025	Investment in civils works, MRF equipment, and vehicles
	<b>Landfill</b>		AED 38 m (capping) AED 55 m (new landfill)	AED 38 m (capping) AED 55 m (new landfill)	2025	Investment in civils works of current landfill capping and new landfill development
	<b>Other waste streams (Wood and IHW)</b>		AED 46 m	AED 23 m <sup>1)</sup>	2026	Investment in wood shredding equipment, co-investment in IHW facility civil work, and required equipment
	<b>Bin and fleets</b>		AED 65 m (2025) AED 30 m (2029)	AED 65 m (2025) AED 30 m (2029)	2025 2028	Investment in new collection/service vehicles, bins, and extra bins serving 2-bin system

Project investment    PSD required investment

CAPEX injection year

*Total: AED 351 m*

*AED 286 m*

1) CAPEX injection needed as 50% shareholder of the JV

## B. Appendix

## **B.1. SteerCo. comments**

# **The following slide highlights key questions raised during the last SteerCo meeting**

Key questions raised during the last steerco (16/01/2025)

- 1** What are the options available for managing landscaping/green waste?

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- 2** What are the savings realized from diverting waste from landfill?

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- 3** What are the market dynamics for compost in the UAE?



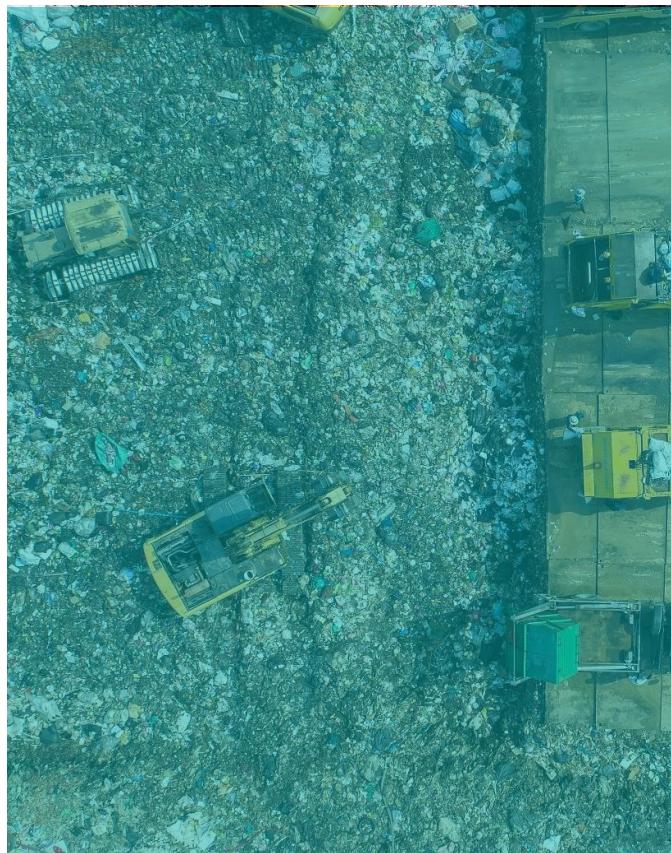
1 What are the options available for managing landscaping/green waste?

# Green/Landscape waste shredding/drying and sales is the ideal solution due to its simplicity, market availability, and cost-effectiveness

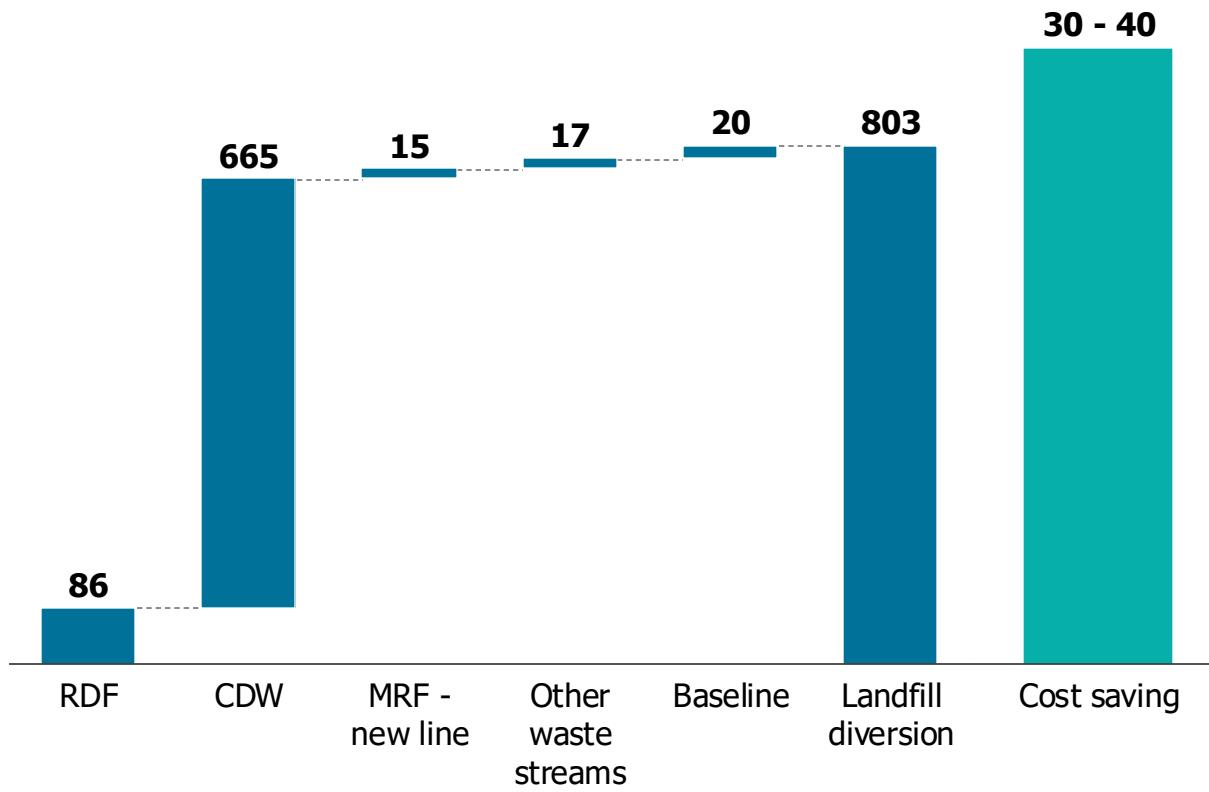
Green/Landscape & manure waste management options				
	Option 1: Shredding/drying & sales	Option 2: Composting	Option 4: Anaerobic digestion	Option 5: Pyrolysis
	Shred and dry green waste and sell them to potential off takers			
<b>Technical &amp; operational complexity</b>	✓ Requires only basic shredding/drying equipment with simple operations	! Requires more technical know and operational expertise	! Requires advanced technology and skilled operators	! Requires assessment of waste to ensure it can produce market-acceptable charcoal/biochar
<b>Off-Take market availability &amp; feasibility</b>	✓ Established off-takers for biomass (e.g. cement plants)	! Might face challenges in securing sales of compost due to limited applications in RAK	! Might face challenges in securing sales of electricity due to higher prices	! Final product may be priced higher compared to other brands due to the limited economy of scale
<b>Cost consideration</b>	✓ Low CAPEX and OPEX	! Mid to high investment needed	! High set-up cost	! Mid to high investment needed
<b>RECOMMENDED</b>				

## Diverting waste from landfill could result in savings of up to ~AED 30-40 m by 2030 and an extended landfill lifespan

Overview of landfill diversion cost saving



Estimated landfill diversion [ volume k tons] and cost-saving [ AED mn p.a.]



### Key takeaway



- By 2030, the implementation of RAK waste management strategy is projected to divert ~ **800,000 tons** of waste from the RAK landfill, achieving a diversion rate of **50%**
- Estimated OPEX per ton for landfill is ~ **AED 40 - 50**
- With the landfill diversion, the annual operating costs are expected to decrease by ~ **AED 30-40 mn**
- As a result, the **lifespan** of the new landfill will be extended

# Local compost production in the UAE is limited, and the market demand potential in Ras Al Khaimah is relatively low

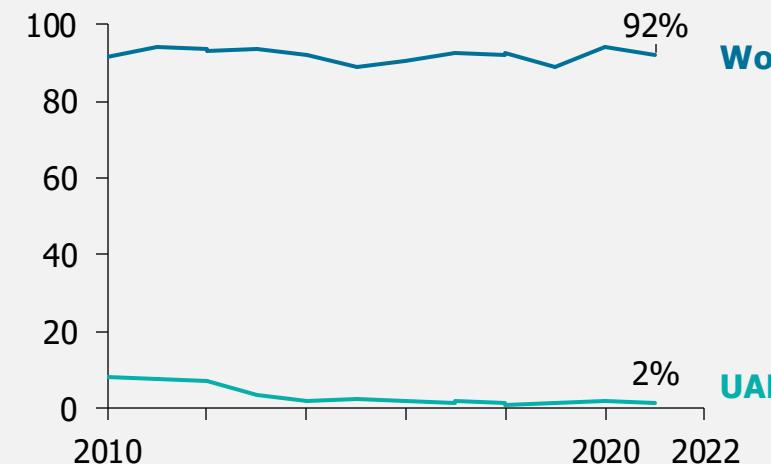
Composting (fertilizer) supply and demand analysis

## UAE composting facility [selected]



## UAE fertilizer demand and supply

Fertilizer consumption [% of fertilizer production]



## Key market drivers

### Demand



Potential buyer but small consumption capability (RAK: ~2-4 t p.a.)



Potential use case but limited consumption capability



Limited use in RAK and UAE due to only 0.7% arable land

### Supply



Facing competition from two major WM and composting players, including Bee'ah, which serves the Northern Emirates



Besides there are several small composting players in Dubai

## Implications for RAK

- UAE utilizes only about **2% of its produced fertilizer**, falling below the global average, 98% of produced fertilizer is exported to other countries
- Initial estimates indicate **low compost demand in RAK, combined with competition from several players**, potentially undermining the justification for a composting plant
- A **comprehensive assessment of offtake potential** is necessary to evaluate the viability of facility establishment

## B.2. Strategy detailing

# The strategy will focus on delivering exceptional waste management services, promoting a sustainable environment for residents and tourists

vision

To deliver exceptional waste management services, promoting a sustainable environment for residents and tourists



## 1. Make city clean & reduce waste generation of MSW and CDW

- 1.1 Enhance the (pre)-collection service level
- 1.2 Explore opportunities for waste reduction
- 1.3 Assess opportunities for landfill management



## 2. Generate revenue from MSW and CDW recycling

- 2.1 Improve MRF performance
- 2.2 Monetize and recycle Municipal Solid Waste
- 2.3 Develop recycling plan for Construction Demolition Waste



## 3. Participate in other waste streams to capture profitability

- 3.1 Develop industrial hazardous waste treatment capabilities
- 3.2 Set-up shredding facility to shred and sell wood waste
- 3.3 Monetize other streams through royalty fees (e.g. UCO) or direct sales (e.g. Tires)

Strategic pillars

Enablers

Organization & governance

Regulations & standards

Awareness

Data management

Financial transparency

2030 targets



Total revenues of AED 120-130 mn



EBITDA margin of 30-35%



30-35% MSW landfill diversion rate



60-70% CDW landfill diversion rate



**B.2.1 Make city clean &  
reduce waste generation of  
MSW and CDW**

### **B.2.1.1 Enhance the (pre)-collection service level**

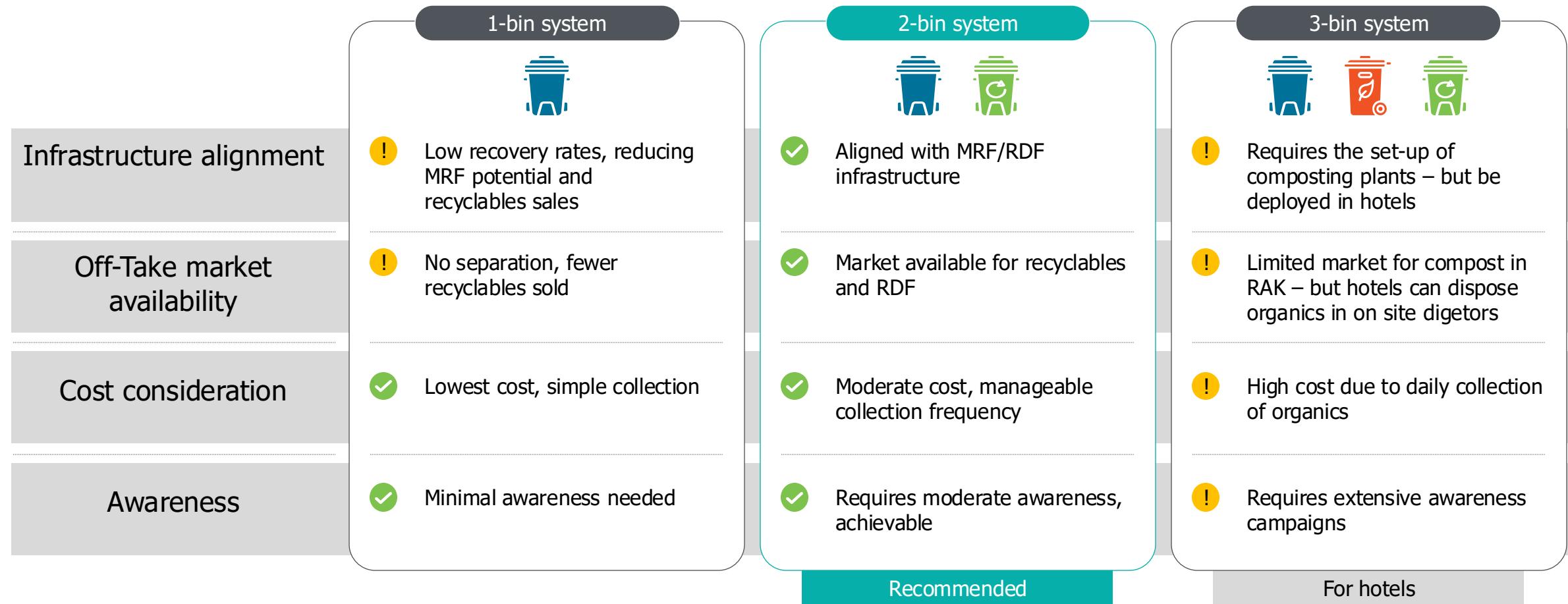
# In order to upgrade its (pre)-collection capability PSD will focus on 3 major focus areas

## Pre-collection focus areas



# A 2-bin system aligns with RAK's waste strategy, while a 3-bin system can be targeted at hotels to effectively reduce food waste

## Bin system comparison



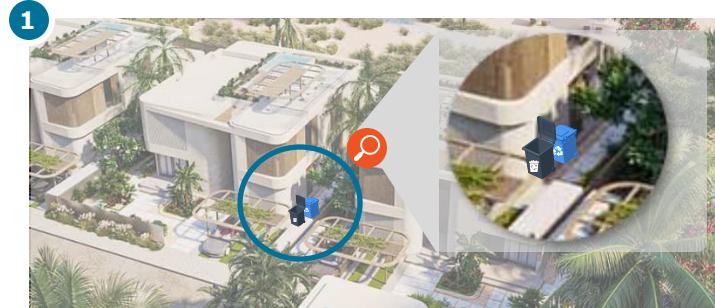
# A two-bin system is recommended for private villas/communities to segregate recyclables and improve recycling rate

Sorting at source – villas/communities

## System design and specs



**Bins deployed in communities and placed inside<sup>1)</sup> properties**



**Bin taken out on collection day at the specified collection time and returned after collection**



### Standardized color codes of bins and bags



### Standardized color codes of bins and bags



### Labels and educational instructions



On each bin,  
showing  
material types



RFID tags on bins to enable data collection

## Key consideration

- PSD will oversee the procurement and deployment of bins
- PSD will establish waste collection contracts with master developers and charge them for the services provided
- A structured collection schedule will be implemented, requiring residents to place bins outside for collection and return them afterward

1) In case of capacity constraint inside the property, bins can potentially be placed outside as well

# A two-stream waste chuting system, supported by digital technology, will be incorporated into new high-rise buildings to enhance recycling rates

Sorting at source – high rise buildings

## System design and specs



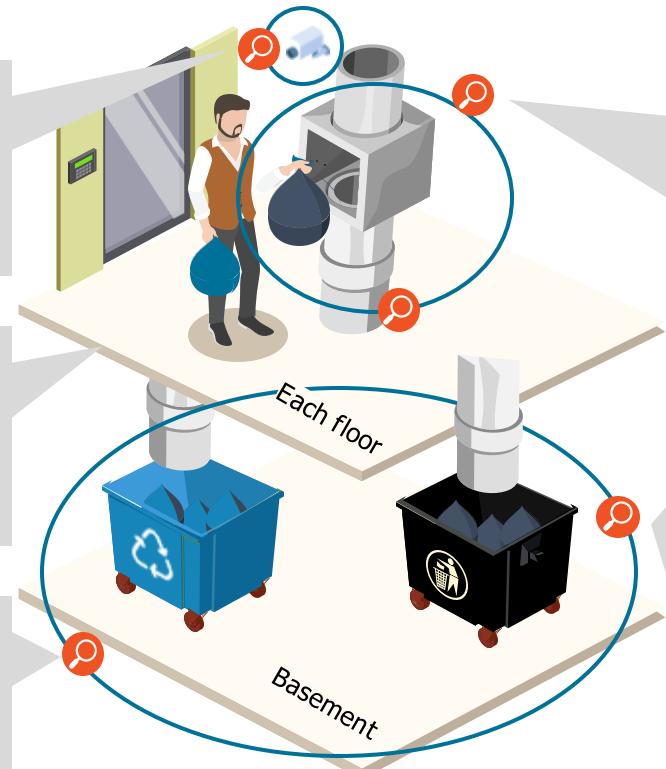
### Key consideration

- PSD will collaborate with RAK Municipality to incorporate a two-stream waste chuting system into the building code, ensuring developers implement this system in new high-rise buildings
- CCTV camera can be implemented to ensure the residents compliance
- Collection contract will be signed with building management with tailored collection schedule

**Digital technology to track the compliance**



Chute access rooms monitored to capture illegal access, wrong placement of bags and contamination



**Single inlet with button to select waste type**



Can alternatively be a chute with 2 inlets for the 2 different waste streams

**Instructions on chute access door or in chute room**



**Types of bins beneath chutes**



720 L or 940 L bin

**Standardized color codes of bins and bags**



# A two-bin system combined with awareness initiatives to promote waste segregation and educate the public on recycling

Sorting at source – public spaces

## System design and specs



## Key consideration

- Implement a two-bin system to emphasize the importance of recycling in the public spaces
- Consider fill-level sensors, compaction, underground bins, and awareness-focused nudging designs to ensure public compliance, raise awareness, and maintain the city's cleanliness



### Unified color codes



### Smart technology integration



Fill-level sensors or compaction<sup>1)</sup>

### Underground bin<sup>1)</sup>



Underground bins to maintain the city's cleanliness and aesthetic appeal

### Data Tracking

Data tracking of waste generation is done on location basis, with limited applicability to trace back to individuals

### Compliance

Primary solution is awareness, clear messaging, and bin lid design



On each bin, showing material types

A "waste nudge" uses subtle interventions to encourage sustainable waste behaviors without mandates

1) Optional

# A three-bin system associating with compactor and composter is ideal for hotels in RAK to enhance recycling efforts and reduce organic waste

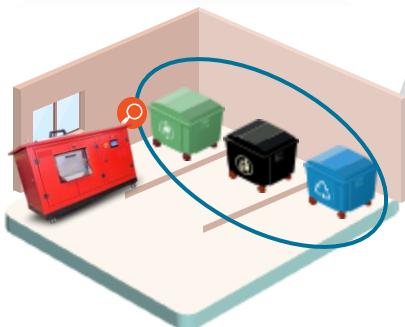
Sorting at source – hotels

## System design and specs



### Waste storage rooms

Inside (ground floor or basement) or in a closed room next to the building



### Standardized color codes of bins and bags



### Collection frequency



Directly treated on site by waste digestors



Minimum weekly



Based on demand of the hotel

### Stainless steel skip for general waste and 1,100-4,500 L bin for recyclables, and smaller plastic bin for organic waste



On each bin, showing material types

### Waste composter/ digester

On-site composter or digester to directly process organic waste collected from organic bins



### Waste Compactor

General waste and recyclable bins can be bought/replaced by waste compactor to reduce collection cost



## Key consideration

- Given the high volume of food waste, a three-bin system will be implemented to facilitate recycling and reduce organic waste
- Organic waste will be treated onsite using decentralized composting or digesting machines, rather than being collected
- PSD will rent out bins while requiring hotels to purchase waste digester machines

# The plan to upgrade the fleet includes buying 129 vehicles, totaling ~40-45 m AED

Fleet purchase plan – WM agency [# of new vehicles to be bought in 2024]

Vehicle type	Vehicles [#]	Status	Expected delivery
<b>Collection fleet</b>			
~80% of budget			
			
Rear Loader HV	20	Under purchase	Delivery within 6 months
Hook Loader (RORO) HV	13	Under purchase	Delivery within 6 months
Rear Loader LV	10	Already Received	-
Golf Car - Mini Tipper With Bin Lifter	9	Postponed to 2025	-
TMC - Truck HV	6	Under purchase	Delivery within 6 months
Drawbar	6	Under purchase	Delivery within 6 months
Skip Loader - Double Skip	5 (4 double 1 single)	Under purchase	Delivery within 6 months
3 Ton Pickup Tipper Body S/C	4	Under purchase	Delivery within 6 months
3 Ton Pickup Cargo Body D/C	1	Under purchase	Delivery within 6 months
Sweeper Manual - Walk Behind	21	Under purchase	Delivery within 6 months
Vacuum Cleaner - Pedestal	10	Postponed to 2025	-
Sweeper Truck - Mechanical	5	Under purchase	Delivery within 6 months
Skid Steer Loader	3	Already received	-
Street Washer	2	Postponed to 2025	-
Vacuum Cleaner - Manual	2	Postponed to 2025	-
Backhoe Loader Wheeled	1	Already received	-
Waste Trailer With Compactor - (70cbm)	5	Under purchase	Delivery within 6 months
Tractor heads for waste trailers compactors	4	Under purchase	Delivery within 6 months
3 Ton Pickup Cargo Body S/C	2	Under purchase	Delivery within 6 months
<b>Ground cleaning &amp; sweeping fleet</b>			
~10% of budget			
			
<b>Transfer station fleet</b>			
~10% of budget			
			

**Total cost ~Σ 40-45 m AED**

**Total vehicles**

**129**

# Dubai Technologies will support PSD with upgrading its fleet on both Hardware and Software

## Fleet GPS upgrade

### Technology provider



- Dubai Technologies is the leading UAE provider of **smart transportation** and **fleet solutions**
- They have strong expertise in **tracking, monitoring, and optimizing fleet operations**
- PSD has awarded a contract to dubai technologies to help them both with software as well as hardware upgrades for it's collection fleet



### Software upgrades

A unified waste management platform with subscription costing 600 k AED per year

- **Route optimization** and dispatch planning for efficient operations
- **Improved collection cycles** using data-driven insights
- **Real-time monitoring** for dynamic resource allocation



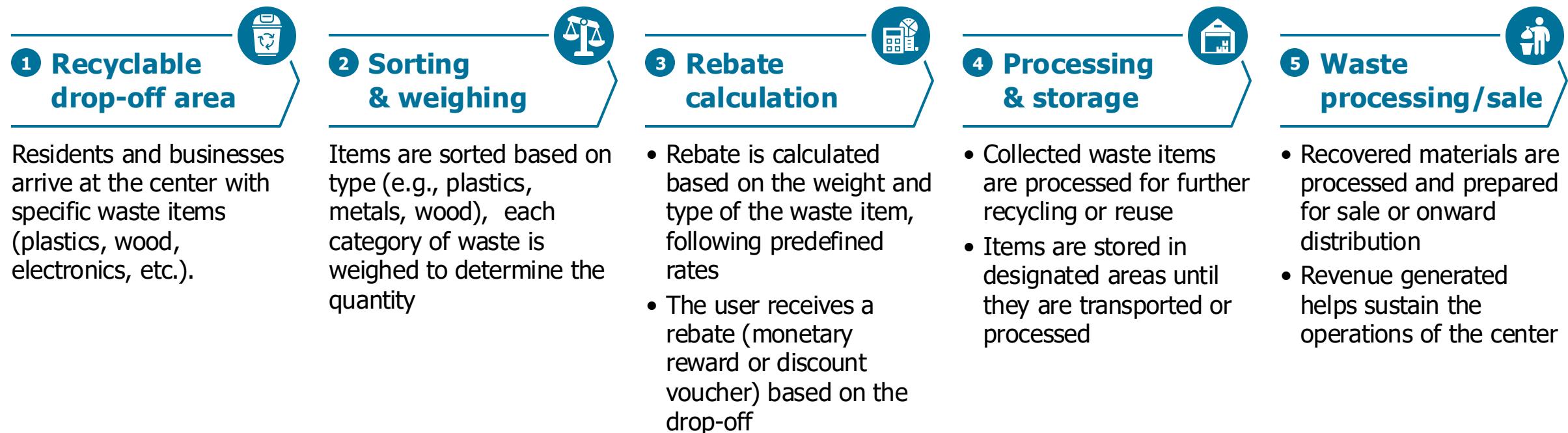
### Hardware upgrades

- RFID for bins
- Weight sensors in trucks
- GPS tracker on vehicles



# Waste collection centers could act as official points to incentivize residents and scavengers to hand in valuable waste, enhancing recyclable recovery rate

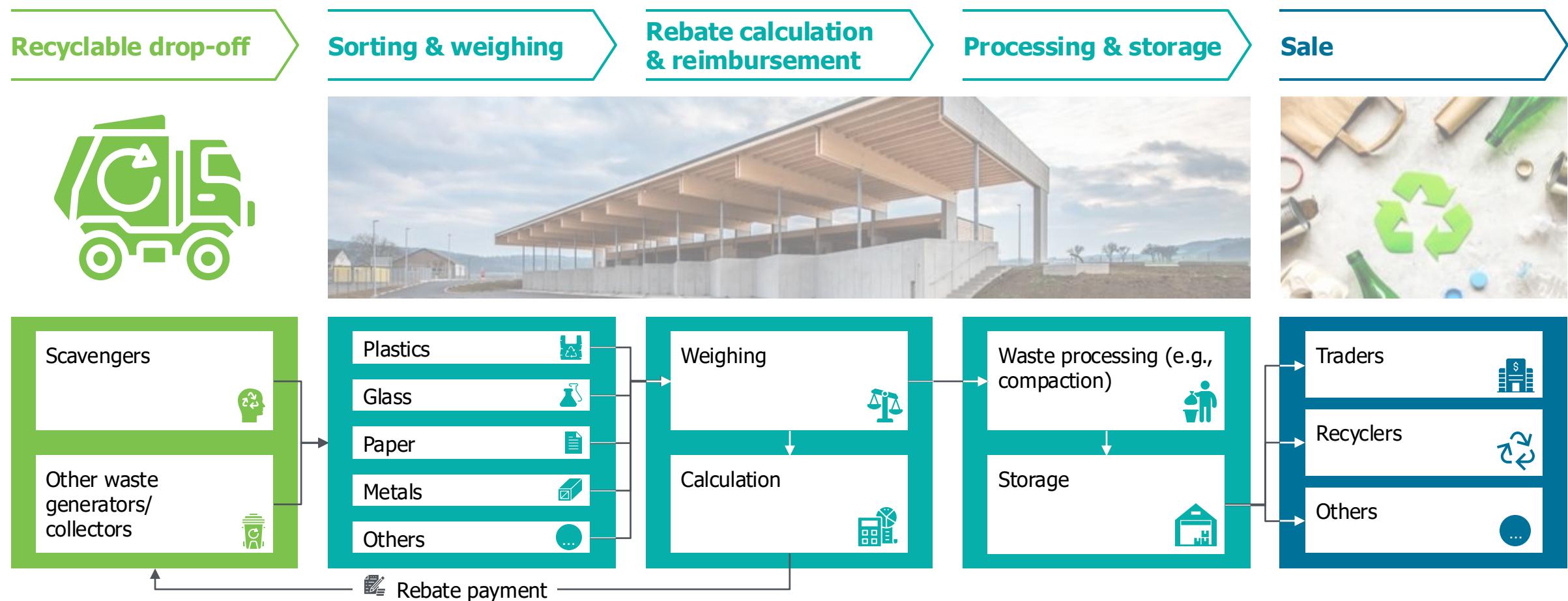
## Collection center outline



Establishing well-designed collection centers significantly boosts recycling rates by formalizing waste drop-off, incentivizing participation, and ensuring efficient sorting and processing of valuable materials

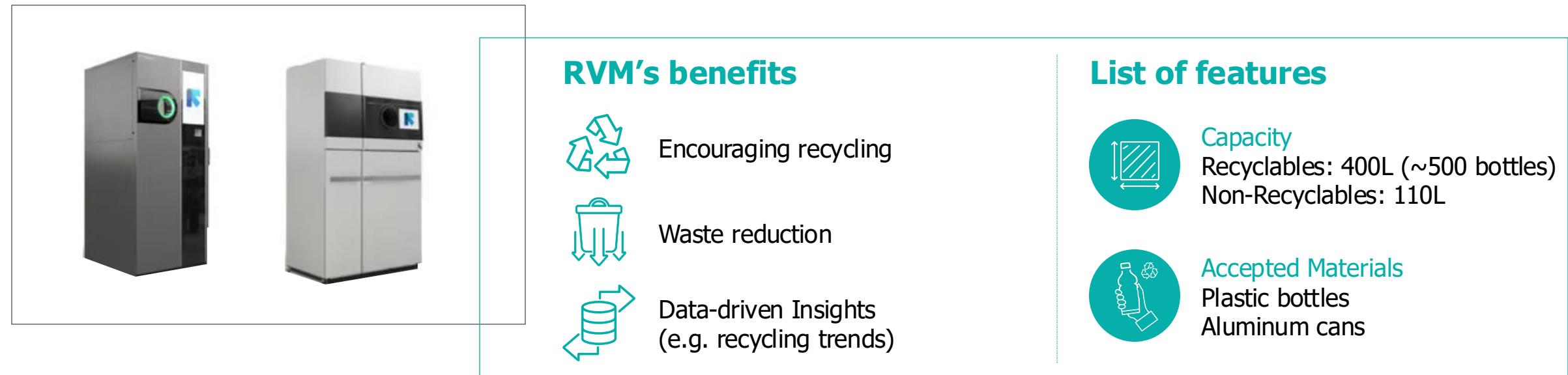
# Waste collection centers could act as official points to incentivize residents and scavengers to hand in valuable waste, enhancing recyclable recovery rate

Collection center schematic



**In addition, PSD could initiate a trial for RVMs to which population can dispose plastic containers and aluminum cans and get rewarded for that**

Reverse Vending Machines (RVM's) specification and collection process

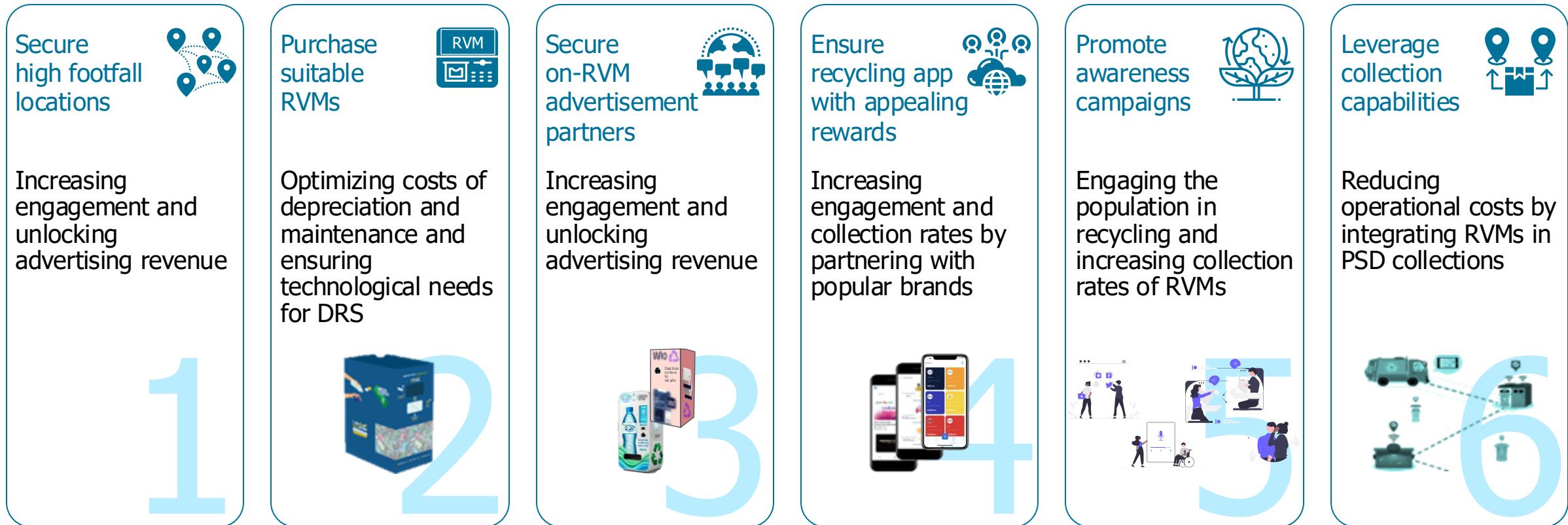


### How it works



# The RVM operating model focuses on engaging users and unlocking multiple revenue streams, leading to a profitable business; high footfall locations are key

Target operating model for PSD RVMs trial roll-out



# By deploying RVMs, PSD can generate additional revenue through the sale of recyclables and RVM advertising, while promoting recycling awareness

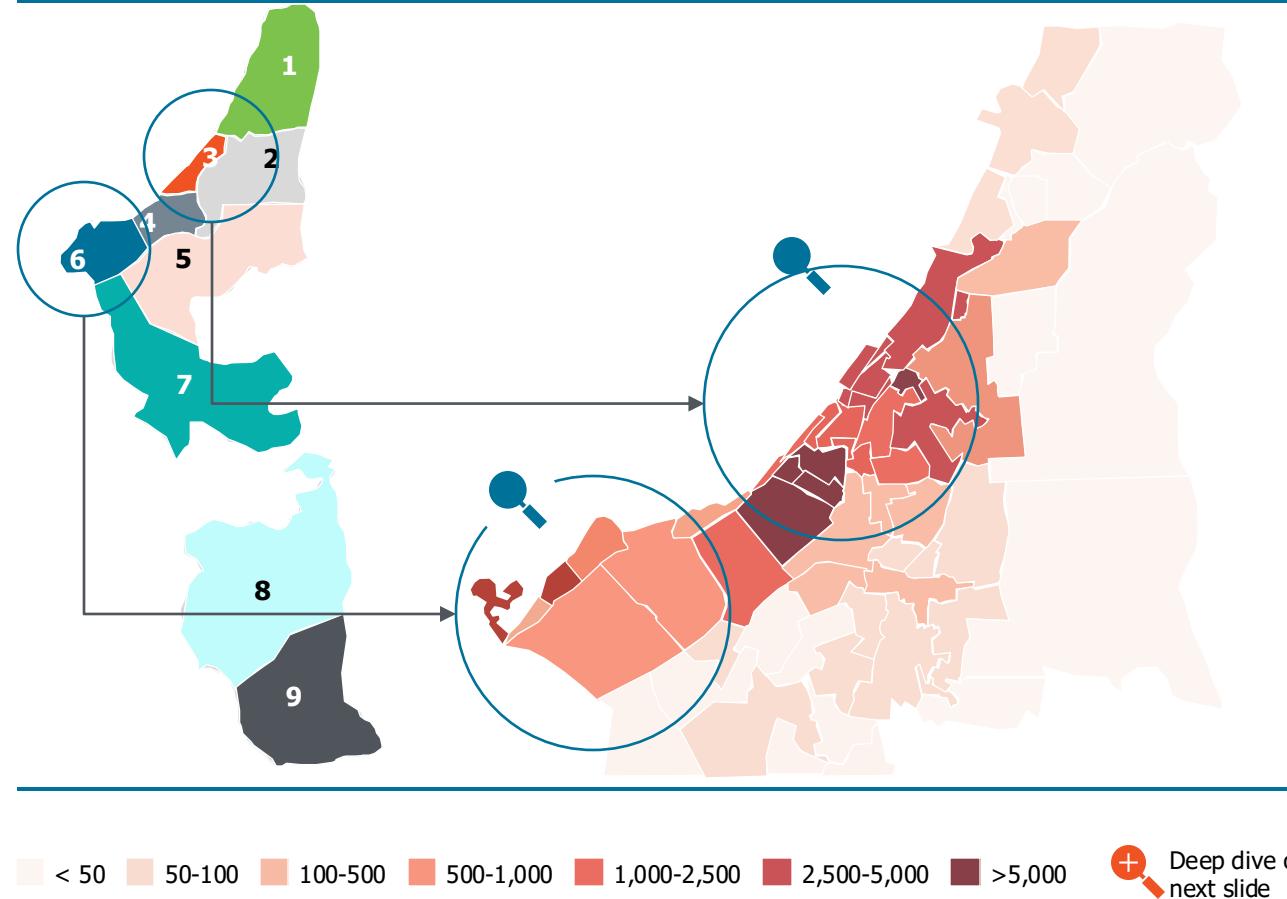
Overview of RVM vendors and business model



# In order to further boost recycling, we propose the piloting of collection centers and RVMs starting in high-density areas

Collection of recyclables

## RAK sector and population concentration



In high population concentration areas of **sector 3 and 6**, to improve **recycling and generate revenue**, we can pilot:

### Collection center



### Reverse vending machine



**Ideal piloting location should have features of:**



High traffic



High frequency of visits



Convenient



~20

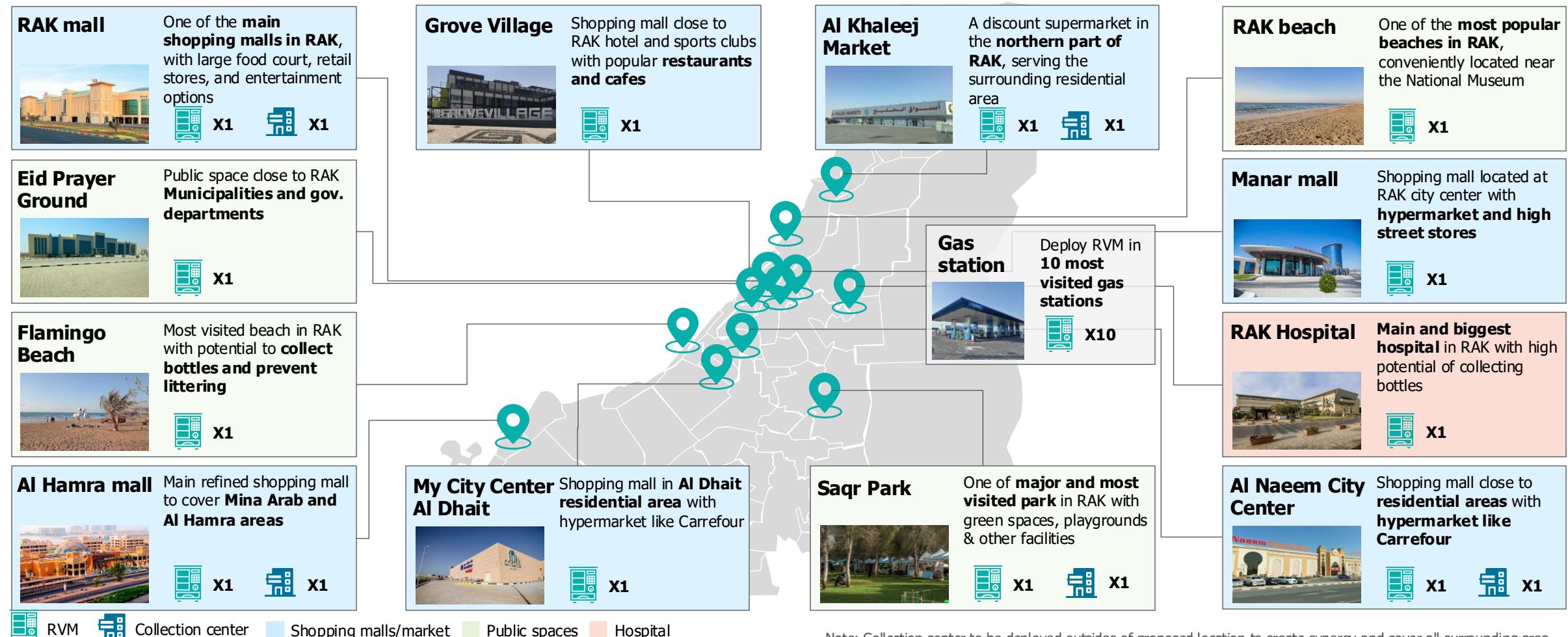
expected # of RVM

~ 500-600 k

required CAPEX for RVM

# RVMs and collection centers should be strategically placed in high-traffic areas such as malls, popular public spaces, and hospitals to maximize participation

Potential location for RVM and collection center



## **B.2.1.2. Explore opportunities for waste reduction**

# The waste reduction approach involves three steps: identifying target waste, defining reduction measures, and measuring impact

## Approach for waste reduction

### 1 Identify major waste source

We assess and define **waste generation sources in RAK** based on waste composition to identify target audiences

### 2 Define waste reduction measures

We explore waste reduction measures from **2 main perspectives** and **tailor the strategy** to suit the target audience

#### Waste reduction via technology

Implement proper technology to enable waste reduction effort

#### Policy and awareness

Leverage policies and campaigns to influence and enforce behavior change

### 3 Track and monitor progress

We establish measurable and **achievable KPIs and targets** to track progress and evaluate waste reduction efforts

#### KPIs

Milestones and metrics to measure initiative level progress

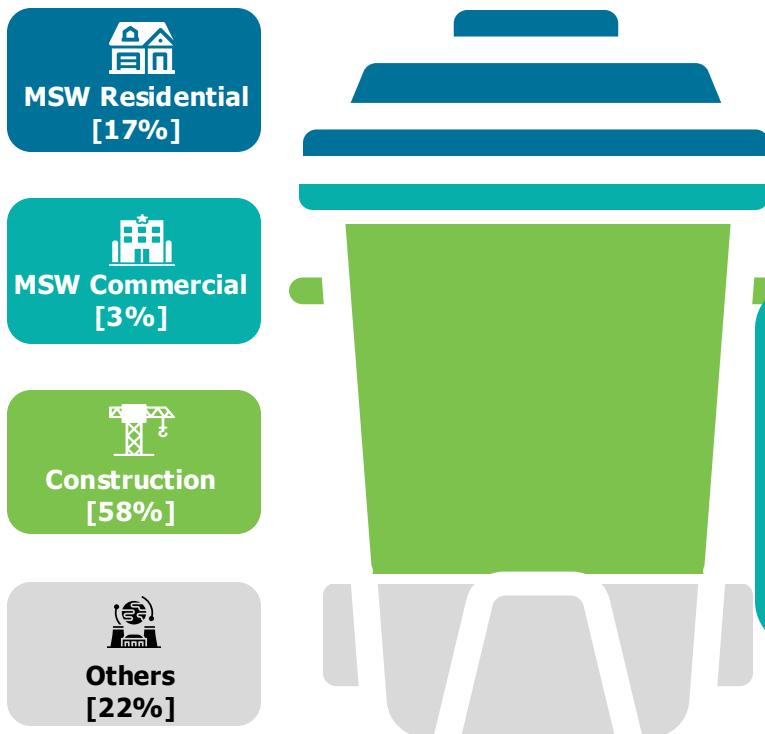
#### Strategic target

Emirates level target to track the regional waste reduction efforts

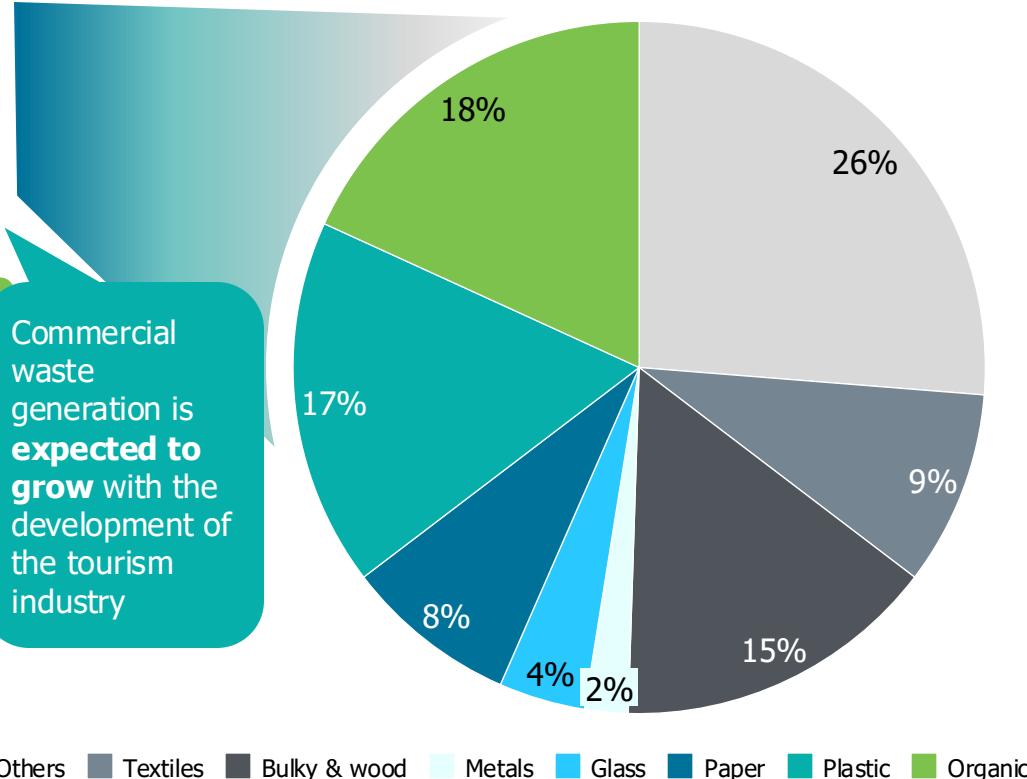
# MSW and CDW make up 80% of the waste composition, making them a top priority for reduction efforts

Major waste generation source in RAK

## Waste generation sources in RAK [%]



## Waste composition [%]



Commercial waste generation is **expected to grow** with the development of the tourism industry

## Key takeaways

- CDW and MSW are the primary types of waste generated in RAK, accounting for **80% of total waste**
- Most of the waste in RAK comes from **construction sites, residents, and commercial entities** (incl. hotels, retail shops, etc.), with anticipated **growth from hotels**
- Within MSW, **organic waste and plastic waste** are the largest contributors, making up **~ 35% of the total composition**
- The main targets of the waste reduction strategy are **hotels and the general public**, focusing on reducing high waste volumes with relative ease, while **construction sites are a secondary target**



# On the technology front, establishing decentralized waste digester at the source can support food waste volume reduction & promote sustainable practice

Plan for food waste reduction

## Target segments

Focus of next slide

### Hotels

Equip hotels with waste digestors to reduce food waste at point of generation



## Target plan

### Phase 1:

Pilot installations in select communities and hotels

### Phase 2:

Scale up based on success metrics, feedback, and capacity building

## Key benefits



**Reduce food waste sent to landfill and waste management cost**



**Lower greenhouse gas emissions**



**Improve circularity by reusing compost in green areas**

## Required enablers

**Organic waste bins** to facilitate sorting at source

**Community and staff training**

**Incentives for participation** (e.g. machine/maintenance subsidy)

**Monitoring and data tracking**



**Objective** Reduce food waste volume and promote sustainable practices in Ras Al Khaimah by establishing decentralized waste reduction at the source

# Two types of decentralized organic waste treatment machines can be deployed on-site to reduce landfill waste and lower waste management costs

## Organic waste treatment technology overview

### Technology

#### Decentralized composting



- A compact, localized system designed to handle organic waste **on-site at its source**
- Converts organic waste into compost through **controlled aeration, mixing, and temperature regulation**

#### Waste digestion to water



- An on-site aerobic food waste digester that uses **microorganisms** to break down food waste into **liquid effluent for discharge**
- The resulting effluent can be further processed at **WWTP**

### Target audience



Hotel



Community



Restaurant



Retail shop

### Cost and providers



oklin



DMS ventures

Green Eco TECHNOLOGIES

Don't waste your waste!

AED 100- 150 k



Hotel



Community



Restaurant



Retail shop



DMS ventures



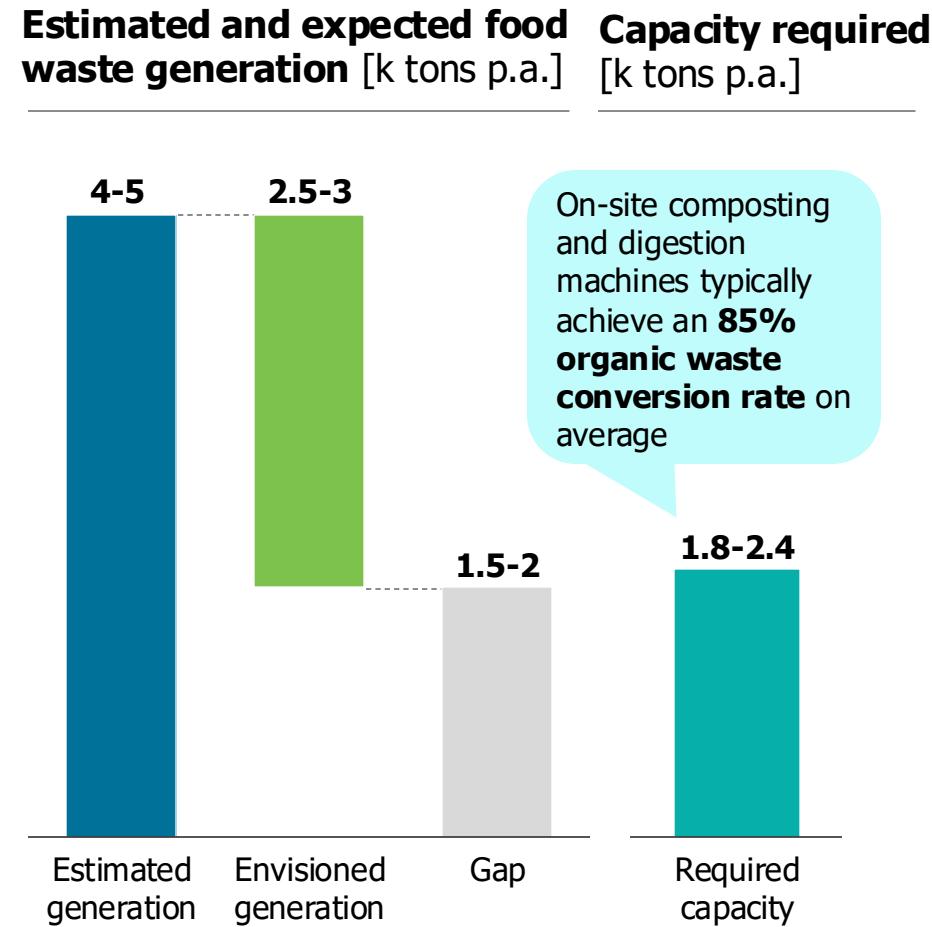
power knot

GF

AED 100- 120 k

# On-site composting/digestion machines can support hotel food waste reduction, with PSD ensuring compliance and mandating installation for large generators

Hotel onsite organic waste treatment project analysis



## Key takeaways



- On-site composting/digestion machines **effectively reduce organic waste generated** at hotels
- A treatment capacity of **1.8-2.4 k tons** is needed to achieve a **30-50% reduction** in hotel food waste
- PSD must **ensure compliance of hotels** with existing composting machines through **regular field inspections**
- For hotels **with no composters**, regulatory measures are needed to **mandate the installation** of composting/digestion machines
- A future **community composting** project can be launched if the hotel pilot project is successful

1) December number not available, estimated as the average of the Jan - Nov

# PSD could initiate the roll-out of on-site composting/ digestion machines at the following five- and four-star hotels in RAK

Hotel target list for on-site composting/ digestion machines

## Iniative description

- For the roll-out of the on-site composting/ digestion machines PSD should target **high-end hotels** in RAK, due to their **size** and **willingness to invest in sustainable initiatives**
- Hotels will purchase and **install on-site food digestor machines**
- PSD will provide **technical guidelines**, and work to ensure proper enforcement across hotel chains

### FIVE star hotels



DoubleTree by Hilton Marjan Island Resort

Marjan Island Resort & Spa

Rixos Bab Al Bahr Resort

Hilton Ras Al Khaimah Resort & Spa

Ritz Carlton RAK, Al Hamra Beach

Intercontinental Resort Mina Al Arab

Ritz Carlton RAK, Al Wadi Desert

### FOUR star hotels



Al Hamra Residence by Deutsche Hospitality

Hilton Garden Inn

Bin Majid Beach Hotel

Mangrove Hotel

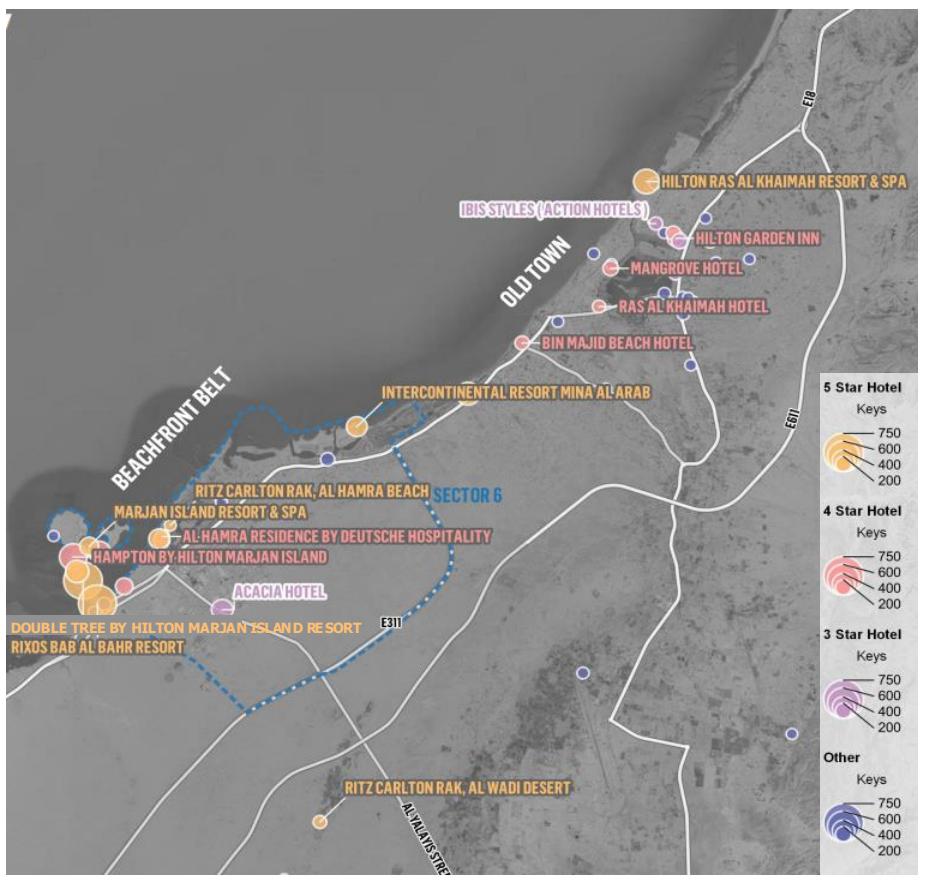
Hampton by Hilton Marjan Island

Ras Al Khaimah Hotel

# Digester/composter initiative can be piloted in large 4-5 star hotels during Q1/Q2 2026 and later expanded to medium-sized hotels

Digester/composter initiative enforcement plan

## — RAK hotel location and size —



2025



**Regulatory framework and guidelines** outlining the requirements for installing digesters and composters



**Incentive mechanisms** to encourage the participation (e.g., Green Hotel Certificate, financial incentive, Tax reduction)

Key activities

2026

Q1

Q2

Q3

Q4

### Initial rollout

Collaborate with **luxury hotels (4-5 stars)** with the **highest key counts** to install digesters or composters

- Plan and rollout initiative
- Identify suitable suppliers



Monitoring the **performance** of the initiative's pilot phase

Conducting **ongoing awareness and training sessions** to support the installation and operation of machines in hotels

### Expand installation

Expand efforts to **medium size hotels (3-4 stars)** to complete initiative

- Collaborate and educate hotel



Monitoring the **compliance** of initiative

# The prioritized policies will support the achievement of Ras Al Khaimah's waste management strategic objectives

## Waste reduction policies

Strategic objec.	Prioritized policy	Description	Proposed parameter variation for RAK
 <p>Reduce waste generation and amount sent to landfill</p>	 <b>Products and materials ban/tax</b>	Introduce a ban or tax on products and materials that can not be recycled or harmful to the environment (e.g., plastic bags)	<ul style="list-style-type: none"><li>Extend current single use plastic bag ban to other <b>single-used plastic products</b></li></ul>
	 <b>Waste fee on commercial</b>	Impose fee on commercial waste generators based on the amount of waste generated to encourage waste reduction	<ul style="list-style-type: none"><li>Implement a <b>multi-component fee structure</b></li><li>Apply a fee on <b>waste volume generated from commercial entities</b></li></ul>
	 <b>Sorting at the source</b>	Set up clear sorting at the source (e.g., 3-bin system) to maximize recovery of materials	<ul style="list-style-type: none"><li>Apply a <b>multi-bin system</b></li><li>Sort <b>2-3 waste streams</b> based on area characteristics</li></ul>
	 <b>Minimum recycled content</b>	Mandate a minimum blend ratio of recycled materials in production manufacturing, construction, and energy supply	<ul style="list-style-type: none"><li>Define a relatively low minimum recycled content <b>rate (10-15%)</b></li><li>Apply policy on <b>construction material and fuel usage</b></li></ul>
	 <b>Extended producer responsibility (EPR)</b>	Mandate producers to be responsible for the impact of their products in the final stage of its life cycle, after consumption	<ul style="list-style-type: none"><li>To <b>collaborate with MOCCAE</b> in developing the EPR framework from the <b>federal level</b></li></ul>



More details information on policies can be found in the policy recommendation report

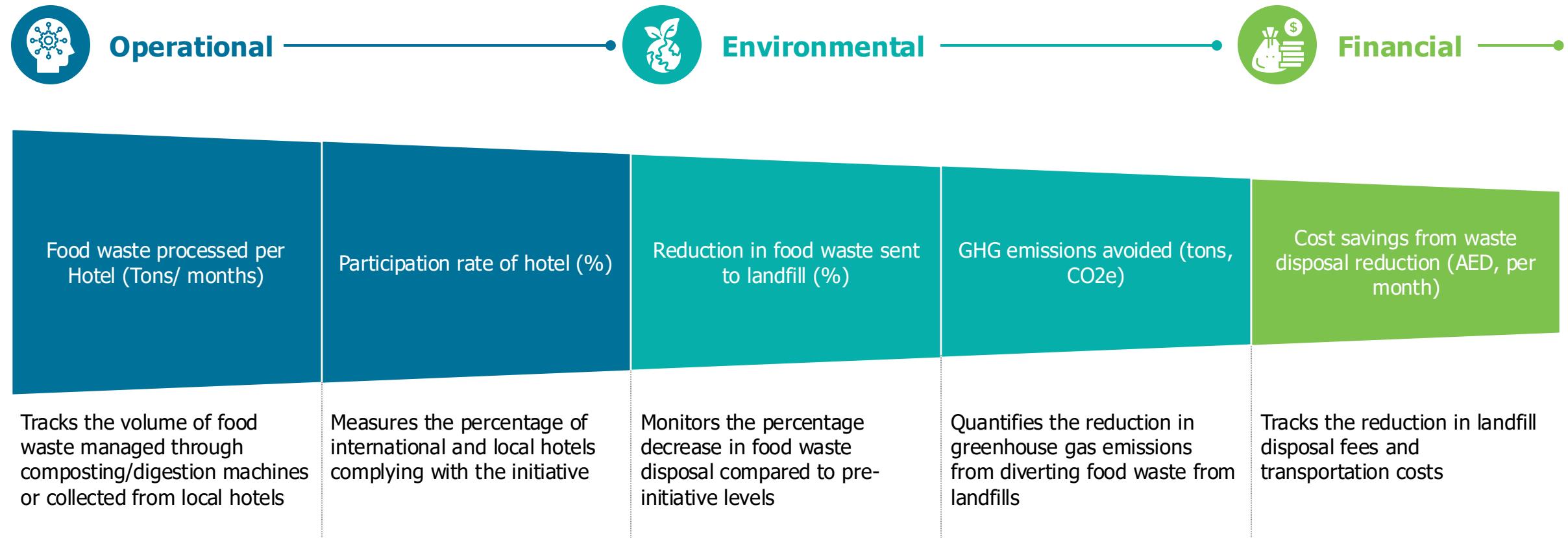
# PSD could initiate two types of awareness campaigns, one targeted on achieving food reduction and one on reducing CDW

Organic waste reduction – awareness campaigns

	Food reduction awareness campaign	CDW awareness campaign
<b>Objective</b> 	Reduce food waste from households, restaurants, and supermarkets	Minimize CDW through better planning, material reuse, and recycling
<b>Target audience</b> 	Households Restaurants Supermarkets Schools	Contractors Developers Municipality
<b>Engagement model</b> 	Social media tips, workshops for businesses, supermarket and communities	Industry workshops, campaigns through professional networks, on-site demos, and digital tools linking sites with recyclers
<b>Impact</b> 	Reduced food waste, lower methane emissions, and increased public awareness of sustainability practices	Less CDW in landfills, increased material recycling, and stronger compliance with sustainability regulations

# To track the progress on food waste reduction, Operational, Environmental and Financial KPI's could be monitored

Potential KPI's – Food waste reduction at hotels



### **B.2.1.3. Assess opportunities for landfill management**

# The strategic options for landfill management are twofold: relocating to a new landfill and exploring solutions for the existing landfills

## Landfill consideration

### Moving to a new landfill

1



- PSD identified a suitable landfill site in the Seih Al Bana area, with around sufficient area to support long-term waste management
- The new landfill design must meet future capacity needs and comply with environmental regulations to ensure sustainable operations

### Exploring solution for existing landfills

2

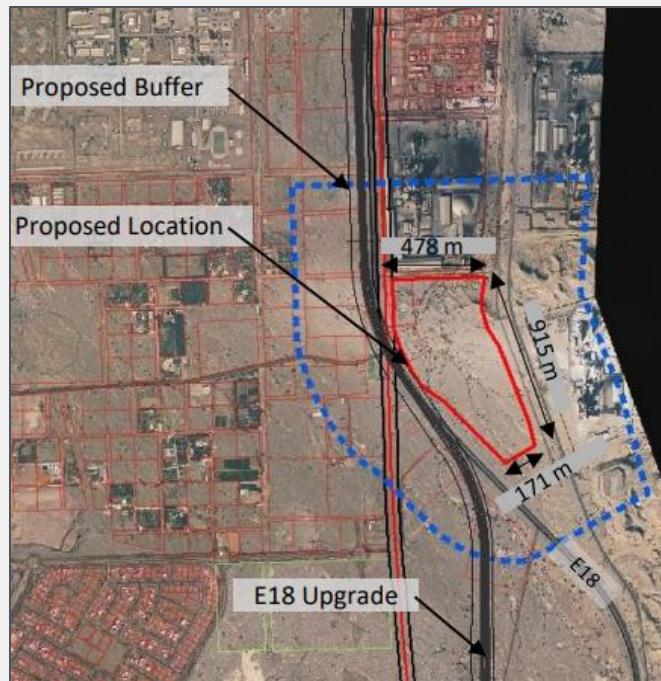


- PSD is evaluating strategic options for the Aljazeera landfill, which has a capacity of 2,300,000 m³ and is currently 60-70% utilized
- There are two options:
  - Landfill capping to secure and contain the existing waste, minimizing environmental risks
  - Landfill mining and reclamation to recover land and potentially extract valuable resources

# PSD has initiated the process of moving its landfill to Seih Al Bana, the new landfill has an area of c. 300,000 m<sup>2</sup>, with an estimated CAPEX of AED 55 m

## Moving to a new landfill

### Map



### General information

Location	Seih Al Bana, RAK
Area	c. 300,000 <sup>1)</sup> m <sup>2</sup>
Expected lifetime	c. 12 years

### Operating model

In-house	Out-source
----------	------------

### Technology

Leachate management	Gas flaring
---------------------	-------------

### Investment category

Investment category	Percentage of total	Cost (Million AED)
Engineered cells (liner System)	50%	27
Site preparation	20%	11
Leachate management system	10%	6
Gas collection system	10%	6
Supporting infrastructure	5%	3
Contingency & engineering	5%	3
<b>Total</b>		<b>55</b>

1) Based on length of 915 m and average width of 325 m

# Landfill can be closed through capping or mining, with mining costing more but enabling future land development

Business model

## 1. Landfill capping & rehabilitation



- The landfill is capped, leachate is treated, and gas can be extracted
- Land can then be transformed into parks, green spaces, or recreational areas

Cost

~30-50 mn AED<sup>1)</sup>

Timeline

1 year

Key consideration

Land cannot be used for building structures but can be repurposed for recreational areas or solar park

## 2. Landfill mining



- Excavating and processing materials to recover resources, and repurpose the site for new uses

~500-700 mn AED<sup>2)</sup>

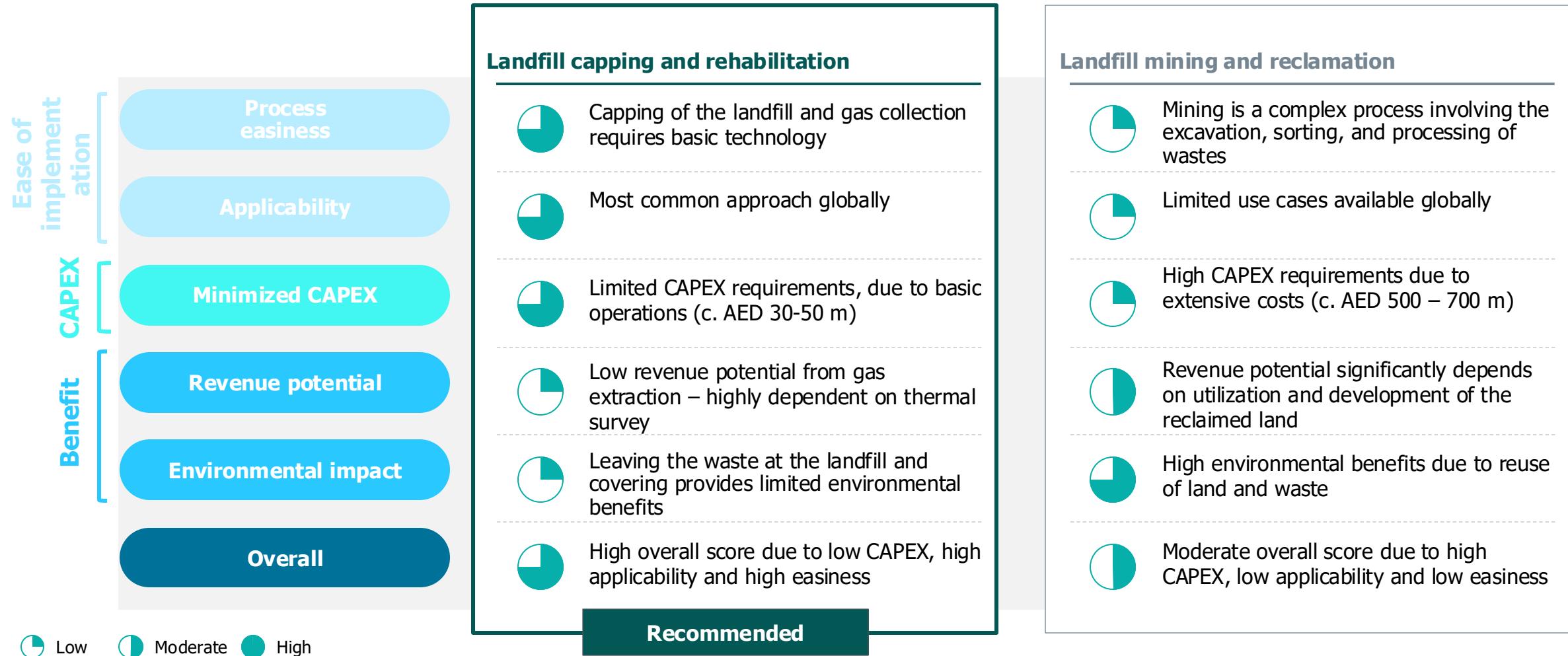
3-4 years

Land can be reclaimed and reused for future construction projects, excess waste must be relocated to a new landfill

1) Based on cost of 300 AED/m<sup>2</sup> for capping, leachate management and gas extraction; 2) Based on cost of 100-120 USD/m<sup>3</sup> for landfill mining

# For the Al Jazeera landfill it would be recommended to conduct capping and cover the landfill, due to minimized complexity and CAPEX requirements

## Strategic options – Al Jazeera landfill closure



# The landfill operating models identified have a direct impact on revenues, operational expenses and capital expenditures

## Assessment of landfill operating models

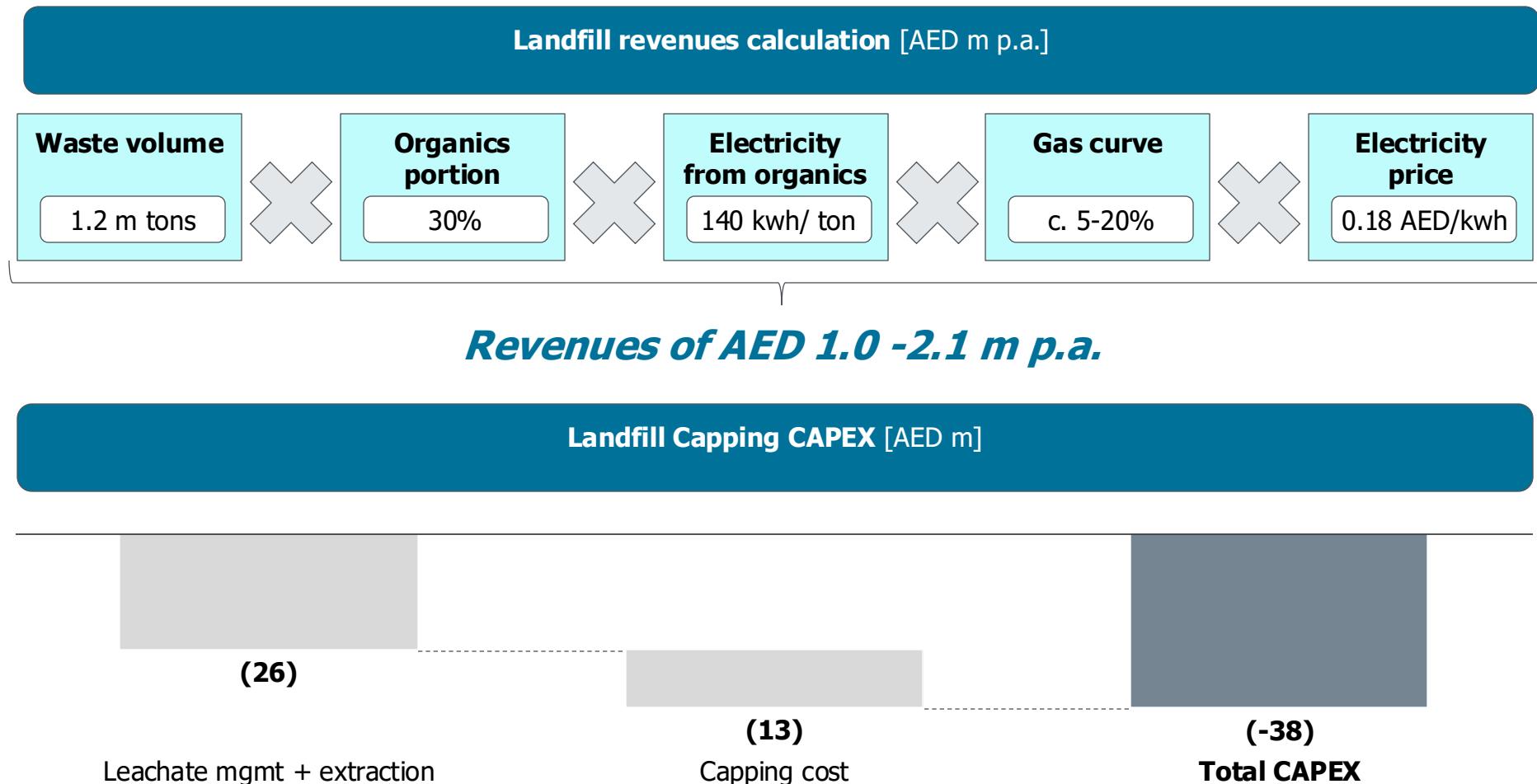
Option # and method	1 Capping + gas flaring	2 Capping + gas + rehabilitation	3 Mining + re-sorting
<b>Revenues</b>			
Gas sale	✗	✓	✗
Electricity from PV panels	✗	✓ <sup>1)</sup>	✗
Recyclable waste sales	✗	✗	✓
Electricity from waste incineration	✗	✗	✗
Fuel production	✗	✗	✗
<b>CAPEX</b>			
Field rehabilitation	✓	✓	✓
Gas/ leachate systems	✓	✓	✗
Gas extraction	✓	✓	✗
PV panels system or green park	✗	✓	✗
Waste mining equipment	✗	✗	✓
Alternative fuel production (RDF)	✗	✗	✓
<b>OPEX</b>			
Landfill operations (incl. labor cost)	✓	✓	✓
Gas/ leachate collection & treatment	✓	✓	✗
Waste mining operations	✗	✗	✓

1) Revenue from photovoltaic (PV) panels will depend on the chosen business model for the landfill—for instance, developing it into a green park versus a solar park

Recommended

# Landfill capping requires c. 38 m AED CAPEX, while only generating c. 1-2 m AED revenues per annum for a period of 8 years

Landfill capping CAPEX and P&L



## Key assumptions

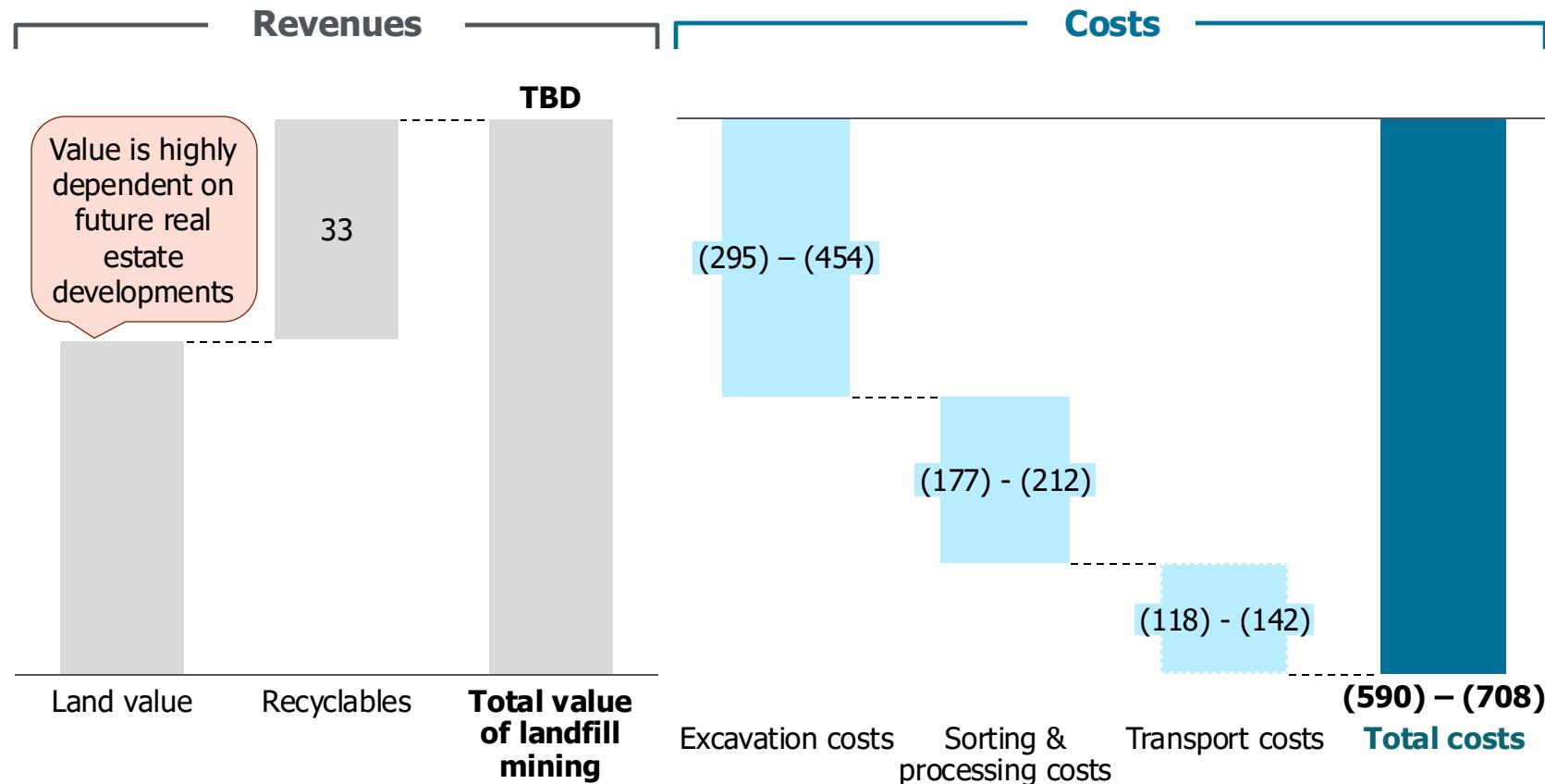


Key assumptions are the following:

- Waste volume of c. 1,200 k tons
- Landfill area of 128,000 m<sup>2</sup>
- Electricity price of 0.18 AED per kwh
- Organics availability of 30% of total waste
- Electricity production of 140 kwh/ton of organics
- Duration spread of electricity production is 8 years
- Leachate management and gas extraction costs of 200 AED / m<sup>2</sup>
- Capping costs of 100 AED / m<sup>2</sup>
- Opex of 15 AED / ton

# Conducting landfill mining activities at Al Jazeera landfill provides limited revenues, while it is cost intensive requiring c. 590-708 m AED

Potential revenues and costs of landfill mining at Al Jazeera landfill, 2025 [AED m]



## Key insights

- Main benefits of landfill reclamations would be limited **recyclable sales** and the **value of the available landfill area** – which is highly depended on the real estate developments
- The following key assumptions have been used for determining the potential value effect:
  - A landfill volume of 2,300,000 m<sup>3</sup> with an estimated 70% waste occupancy and a waste density of 750 kg/ m<sup>3</sup>
  - A total amount of c. 1,200 k ton of waste, with a share of 5% of recyclables, sold at 550 AED per ton
  - Total reclamation costs in between 367–440 AED/ m<sup>3</sup> distributed as follows:
    - Excavation and sorting (50%)
    - Internal re-landfilling (30%)
    - Transport costs (20%)

# The landfill's waste composition consists out of a low share of recyclables which can be sold – compost and RDF feedstock cannot be used due to quality issues

Landfill waste composition [% of total waste]

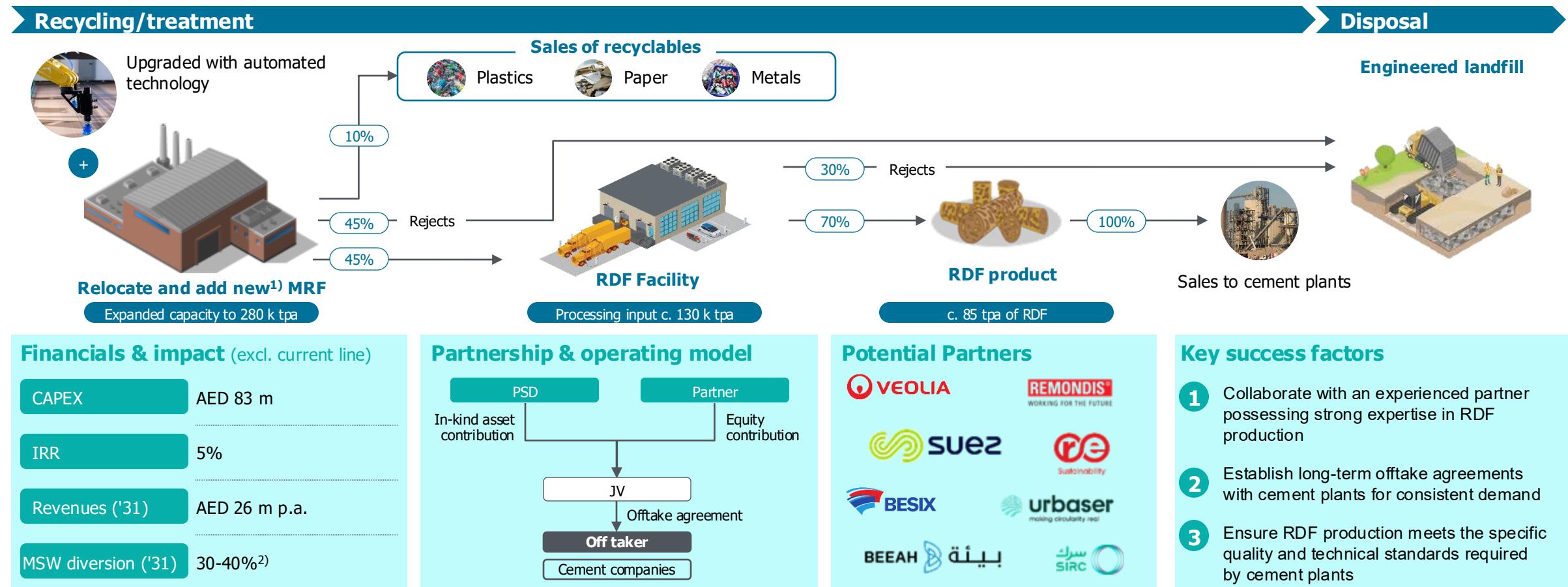
Waste component	Residues	Compost	RDF	Recyclables
	<p>40%</p> 	<p>30%</p> 	<p>25%</p> 	<p>5%</p> 
	<ul style="list-style-type: none"> <li>Residues consist of <b>contaminated fine materials</b></li> <li>Fine materials cannot be used for any end-use – landfilling more probable</li> </ul>	<ul style="list-style-type: none"> <li>The potential quality of the compost is very low due to <b>high contamination levels</b></li> <li>Compost cannot be used as a fertilizer – landfilling more probable</li> </ul>	<ul style="list-style-type: none"> <li>The potential <b>quality</b> of the RDF feedstock is <b>low</b></li> <li>This quality does not adhere to UAE standards, thus domestic <b>offtake potential is very low</b> – landfilling is more probable</li> </ul>	<ul style="list-style-type: none"> <li>Recyclables can be <b>sold to traders</b></li> <li>Split to be further defined by waste sample study</li> </ul>
	<p><b>95% of feedstock goes to landfill</b></p>			<p><b>5% is sold to traders</b></p>
xx% % of total waste composition				

## **B.2.2. Generate revenue from MSW and CDW recycling**

## **B.2.2.1. Improve MRF & establish RDF**

# Establishment of a new MRF and RDF plant will generate 26 m AED in additional revenue, requiring an investment of 83 m AED to be executed through a JV

## New MRF line and RDF plant overview



1) new line has capacity of 170 k tons p.a. 2) Based on current MRF baseline recyclable volume c. 19 k tons (incl. 13 k ton cardboard trading), 15 k tons from new line and 86 k ton RDF and c. 260 k ton of MSW collected

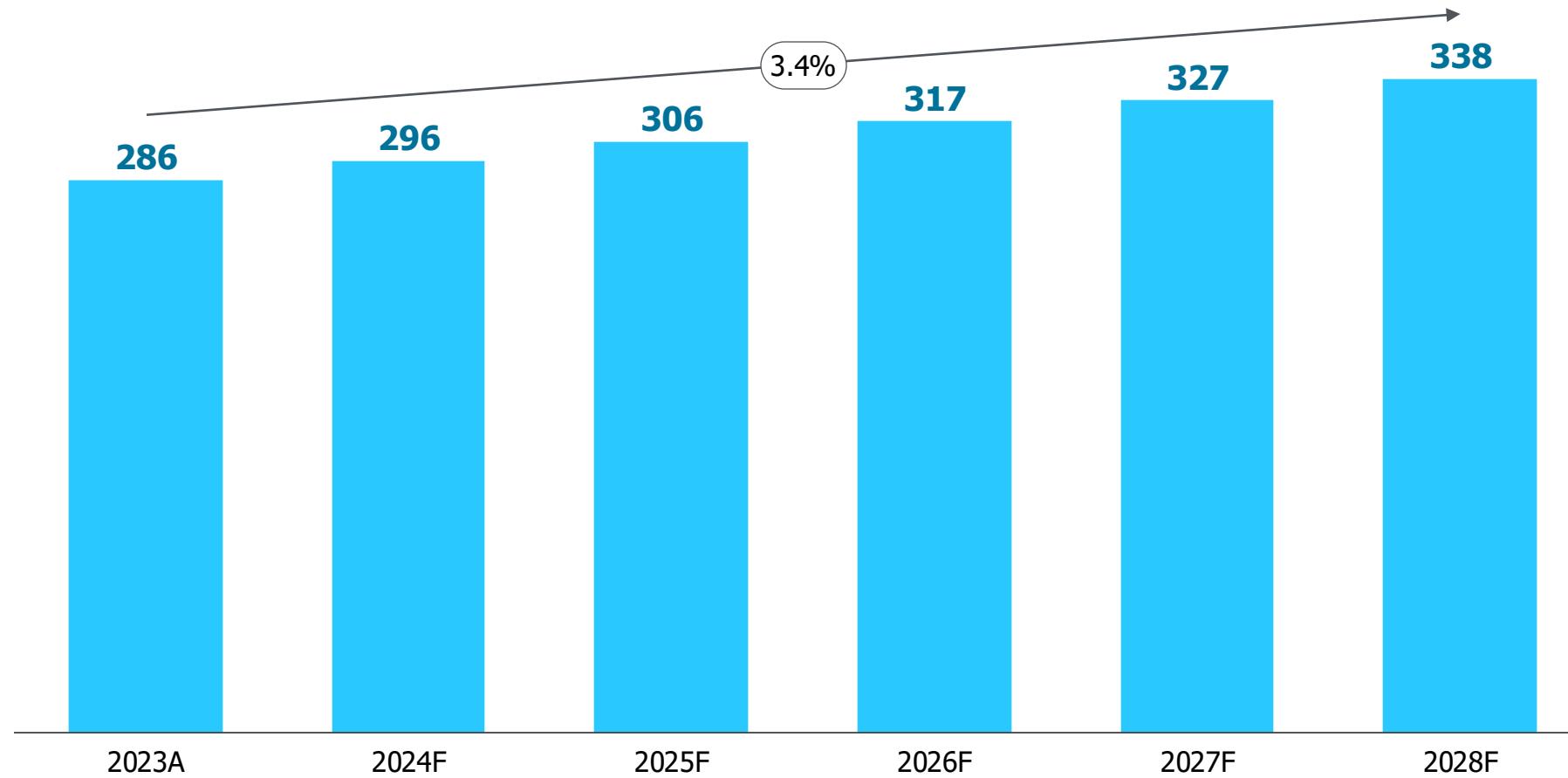
xx% % of waste volume processed in the previous treatment step

# Feedstock strategy



# Total generated MSW in RAK is expected to reach 338 k tons p.a. in 2028, mainly driven by a population growth of 3.4% p.a.

MSW generation in RAK [k tons p.a., '23-'28]



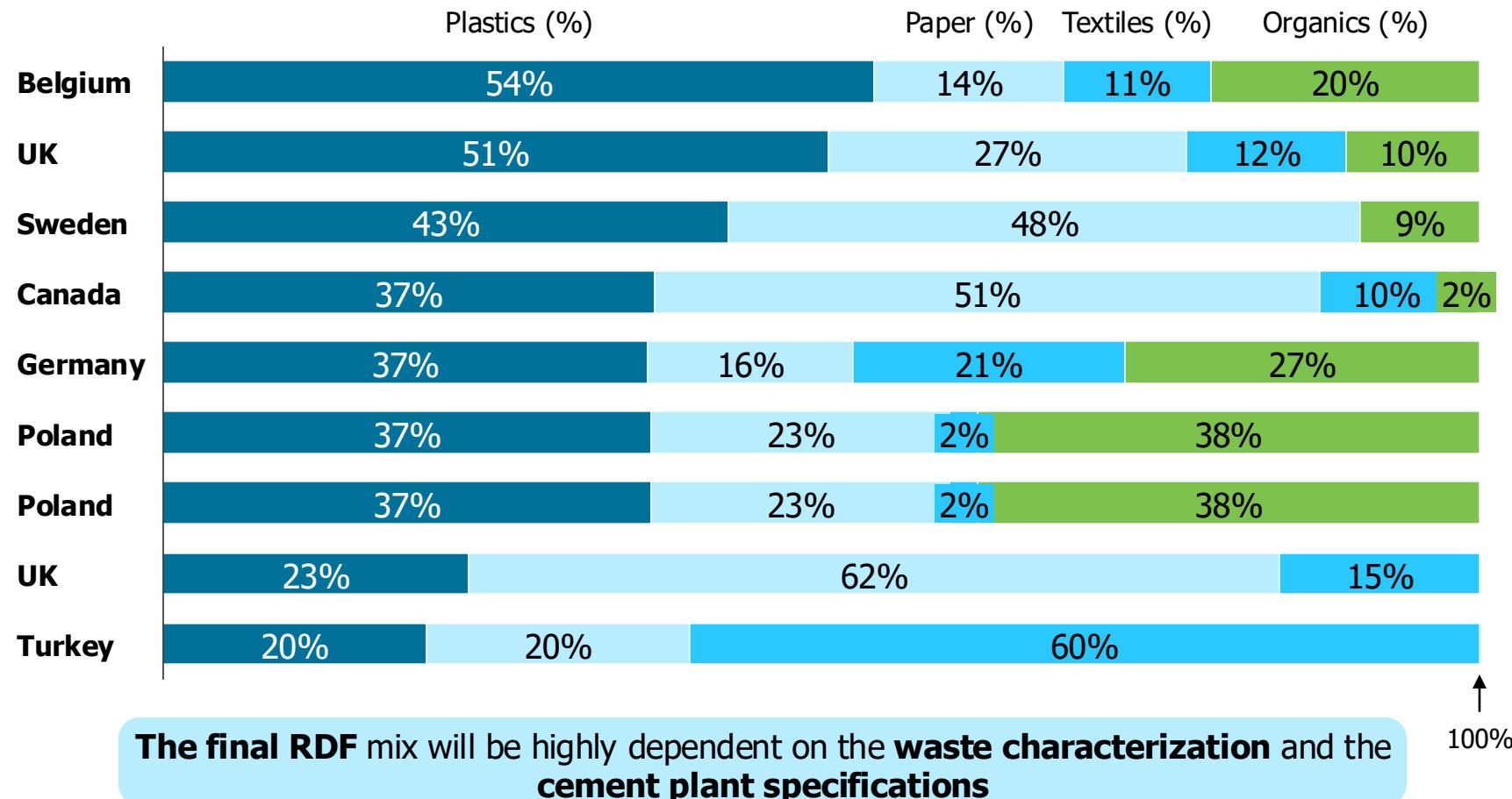
## Key assumptions



- The generated MSW in RAK is expected to grow with c. 3.4% p.a., reaching 338 k tons in 2028
- The forecast has been driven by a current ('23) population of c. 400 k with a growth rate of 3.4% p.a

# Benchmark analysis indicates that RDF composition consist out mostly of plastics, paper and textile

RDF output composition benchmark



## Key takeaways



- Plastics are a major contributor to RDF, accounting for **20% to 54%** of its composition due to their **high energy content** and **prevalence in municipal waste**
- Main types of plastics are **plastic film (PE)**, **rigid plastics (PP)** and **disposable packaging and foam products (PS)**
- These plastics are often **difficult to recycle** due to contamination, mixed materials, or lack of recycling infrastructure, making them ideal candidates for energy recovery in RDF

# Tech and operations



# For MSW processing and treatment PSD, could consider expanding & relocating the MRF, in addition it could consider to set-up an RDF extension to the MRF

Strategic options MSW processing and treatment

## 1 Expand & relocate current MRF



- Relocate the existing MRF to the new landfill site, expanding its capacity to process higher volumes of waste
- Design the new MRF with advanced automation to improve recovery rates and reduce operational costs
- Maximize revenues by increasing the volume and quality of recyclables recovered

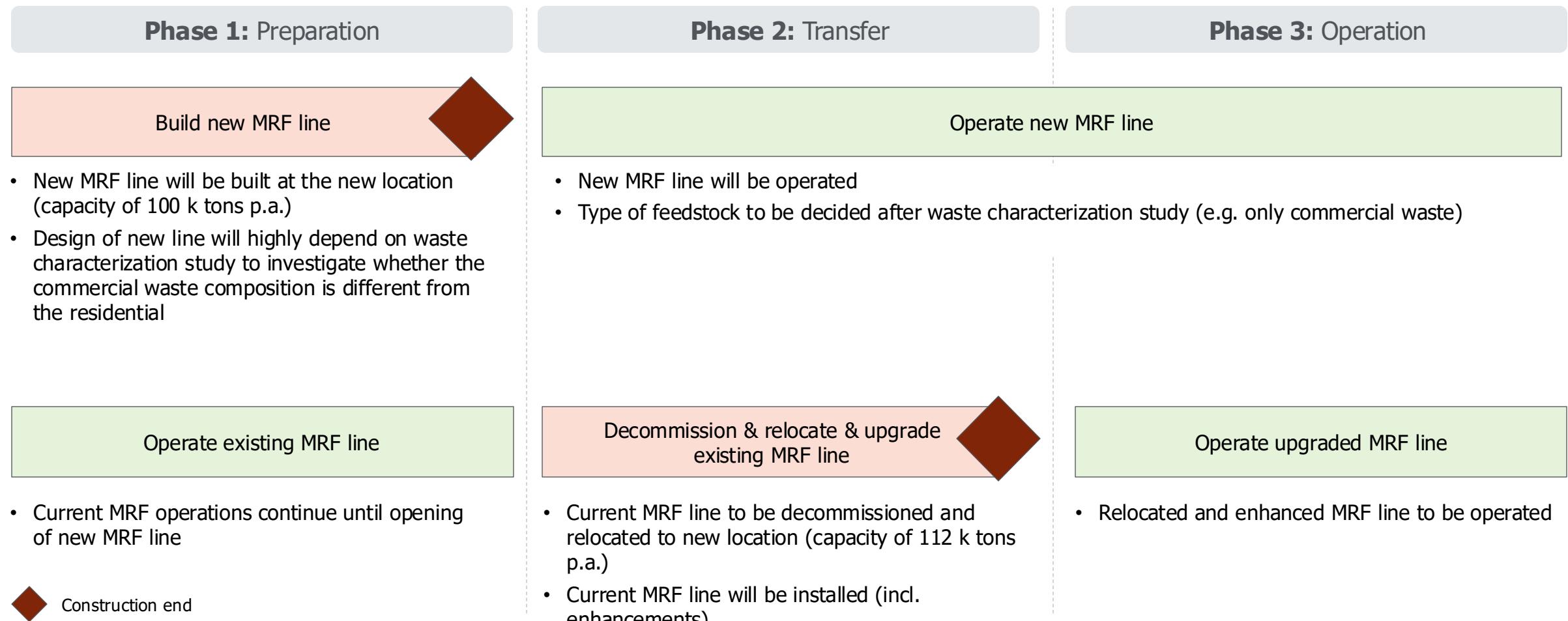
## 2 Set-up RDF as an extension to the MRF



- Extend the MRF by adding an RDF facility to process residual waste into high-calorific RDF pellets
- Target cement plants as key buyers, leveraging their demand for alternative fuels
- Optimize waste utilization by converting non-recyclable fractions into a revenue-generating product

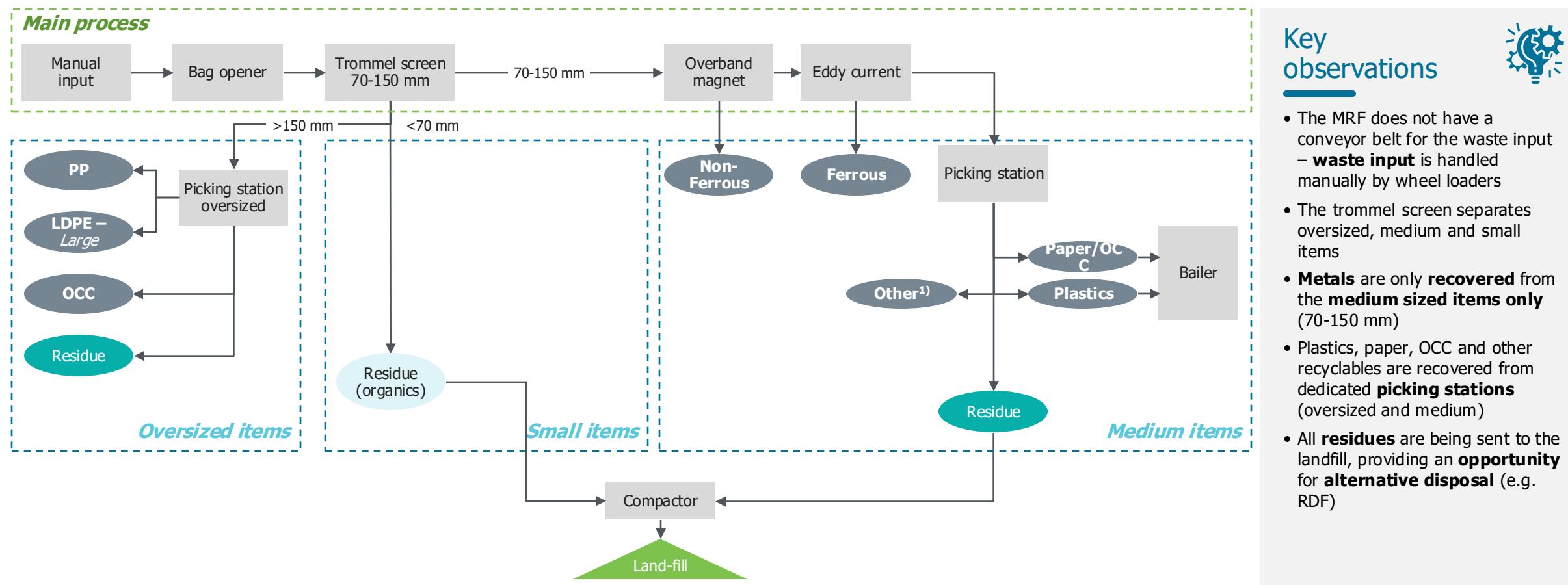
# MRF expansion and relocation can be conducted in process consisting out of 3 phases, in order to limit operational disruption

## MRF expansion and relocation timeline



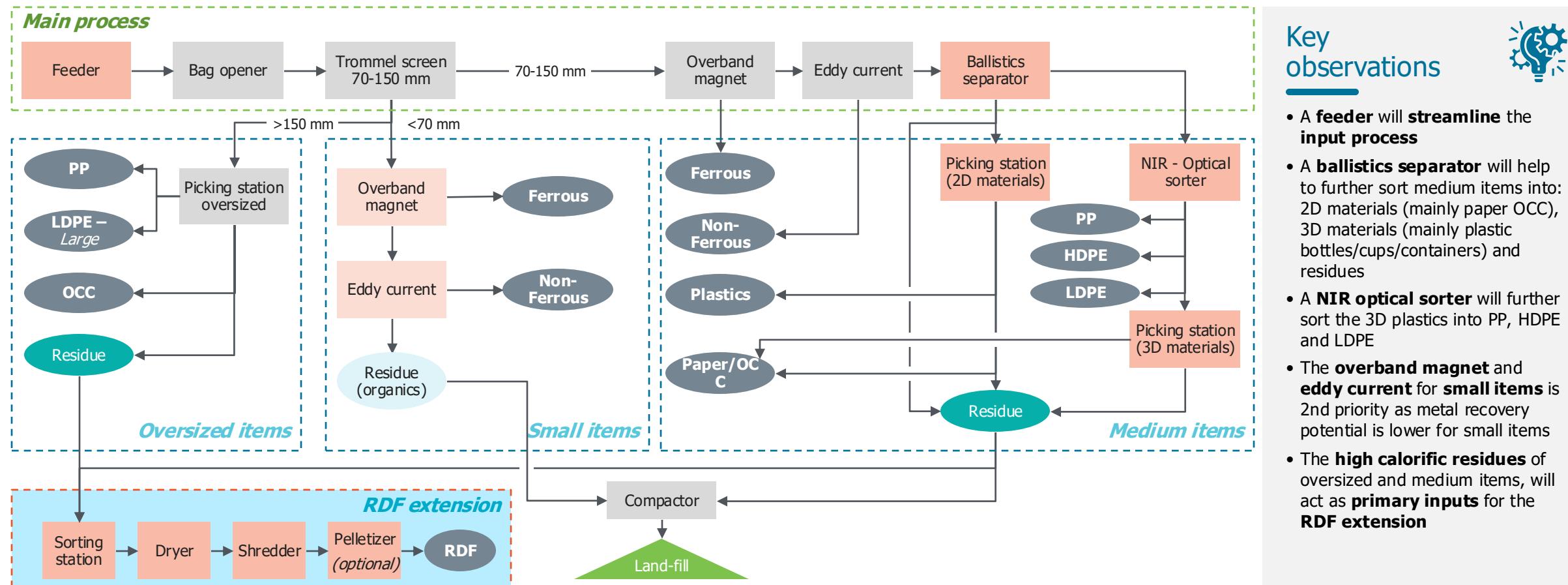
# The MRF could be upgraded to improve recovery rate, in addition it's high-calorific value residues could be re-used instead of being sent to the landfill

Current MRF process flow diagram



**By implementing the following upgrades, the MRF could boost recyclable recovery and repurpose high-calorific residues for RDF, reducing landfill use**

## Target MRF process flow diagram



### 1) wood, textiles, etc.

## ● Recyclables & products

### Residue = High calorific value

Residue = Low calorific value

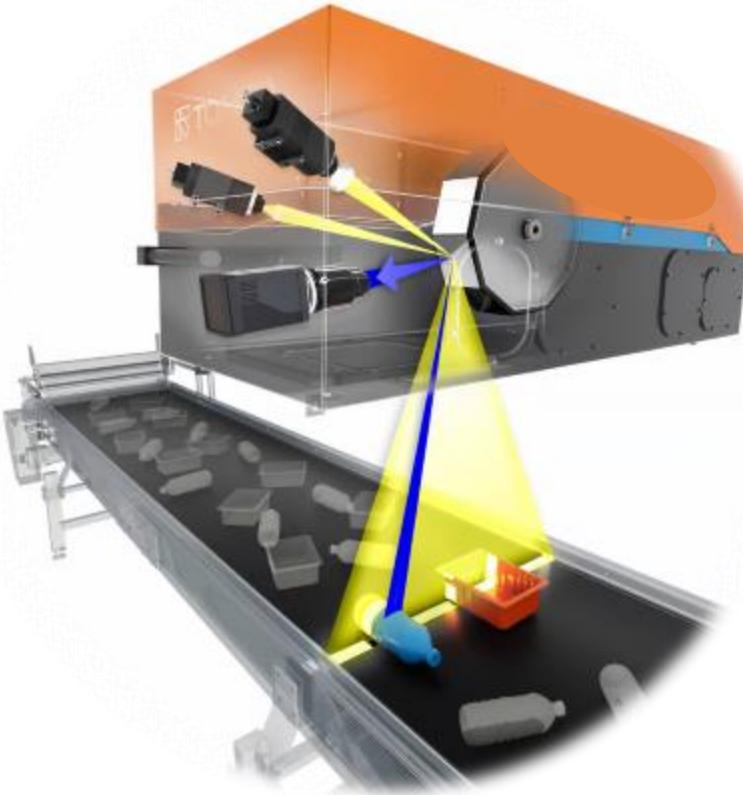
## Current equipment

### ■ New equipment (1st priority)

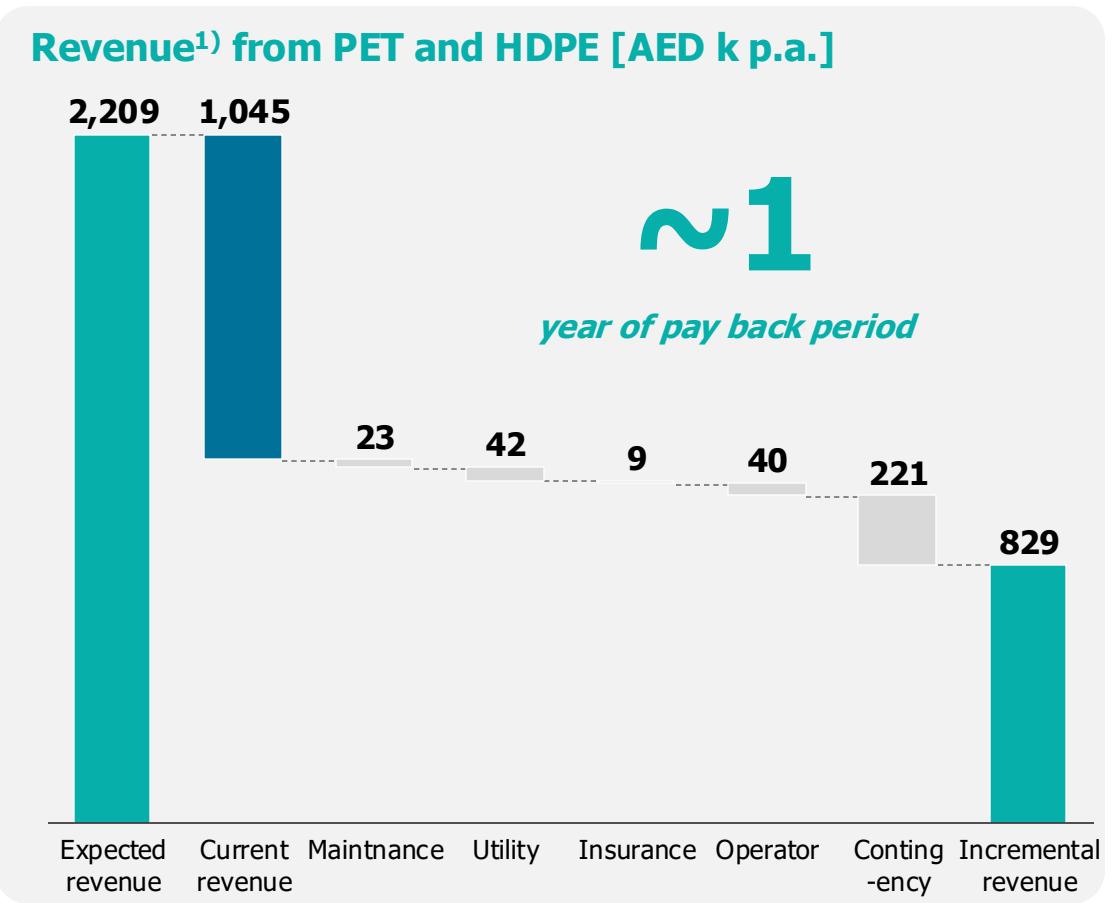
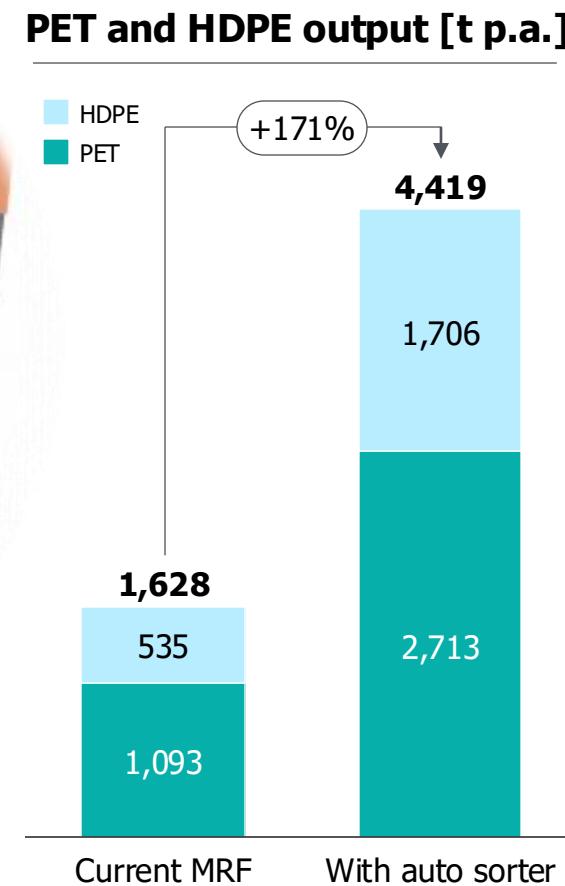
### ■ New equipment (2nd priority)

# An auto sorter can enhance the operational efficiency of the MRF, double plastic (PET and HDPE) output, and generate an additional revenue of AED 0.8 million

Financial impact of auto sorter



**CAPEX required:**  
~ AED 920- 1,000 k



1) Average price of PET and HDPE is AED 500

# The MRF could potentially be upgraded with a conveyor belt, magnetic separator, eddy current, ballistic separator and NIR optical sorter

## Potential new MRF equipment (1/2)

### Conveyor belts



- Mechanical system to transport and handle materials throughout the facility which consists of a series of belts or rollers that are driven by motors
- Use of this equipment reduces manual labor and streamline the sorting and processing operations
- Generally positioned at different angles and heights to facilitate the movement of materials from one stage to another

USD  
20-25 k

### Magnetic separator



- Magnets that attracts ferrous metals a from the rotating conveyor – Ferrous metals are captured and released onto another conveyor or into a storage bunker
- Used to both protect equipment (e.g., crushers, shredders) and to remove ferrous particles and purify products
- The positioning of electromagnetic separators at different points of the process increases the recovery of ferrous metals

USD  
22-26 k

### Eddy current



- Separators which remove non-ferrous metals (e.g., aluminum) from non-metallic material
- Consists of a short belt conveyor that has its drive located at the return end and a high-speed magnetic rotor system installed at the discharge end
- As the eddy current systems rotor spins at these high speeds, an electric current is induced into conducting metals producing a magnetic field which opposes the field created by the rotor, repelling the conducting metals over a pre-positioned splitter plate – Remaining materials will simply free-fall over the rotor, separating them from the repelled metals

USD  
130-150 k

# The MRF could potentially be upgraded with a conveyor belt, magnetic separator, eddy current, ballistic separator and NIR optical sorter

## Potential new MRF equipment (2/2)

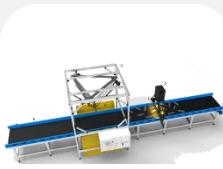
### Ballistic separator



- Consists of a sloping ramp formed by longitudinal perforated plates (paddles) which have a movement of the ballistic type
- Capable of dividing material stream into 3 fractions: heavier 3D fractions (e.g., plastic bottles), lighter 2D or flat fractions (e.g., paper and film) and small-sized fractions (depending on the size of the holes of the grid)
- Can be placed either before or after the trommel depending on plant layout

USD  
30-80 k

### NIR Optical sorter



- NIR technology identifies materials by their unique spectral signatures, using reflected NIR light for rapid analysis on a conveyor belt
- Once identified, materials are sorted using mechanical actuators or air jets, directed into designated bins for each type, automating the recycling sorting process
- It is mainly used in recycling to sort plastics, paper, and fibers, ensuring high-quality standards for recycled materials as it minimizes contamination

USD  
300-400 k

xx

Price range (based on capacity of 25 Tons per hour)

# Innovation such as the use of AI in MRF for sorting can improve recovery rates of various recyclables; Effective pre-collection is a prerequisite

Overview of MRF sorting and processing innovative technologies

## MRF automation & intelligence



Cutting-edge AI solution enables MRFs to **maximize recovery of metals**



Robot trained by thousands of images, to recognize & sort recyclables



Detection & sorting technology **enhancing the recovery of plastics**



MRF dashboard to visual performance of recyclables recovery

## Selection of tech providers



**TOMRA**

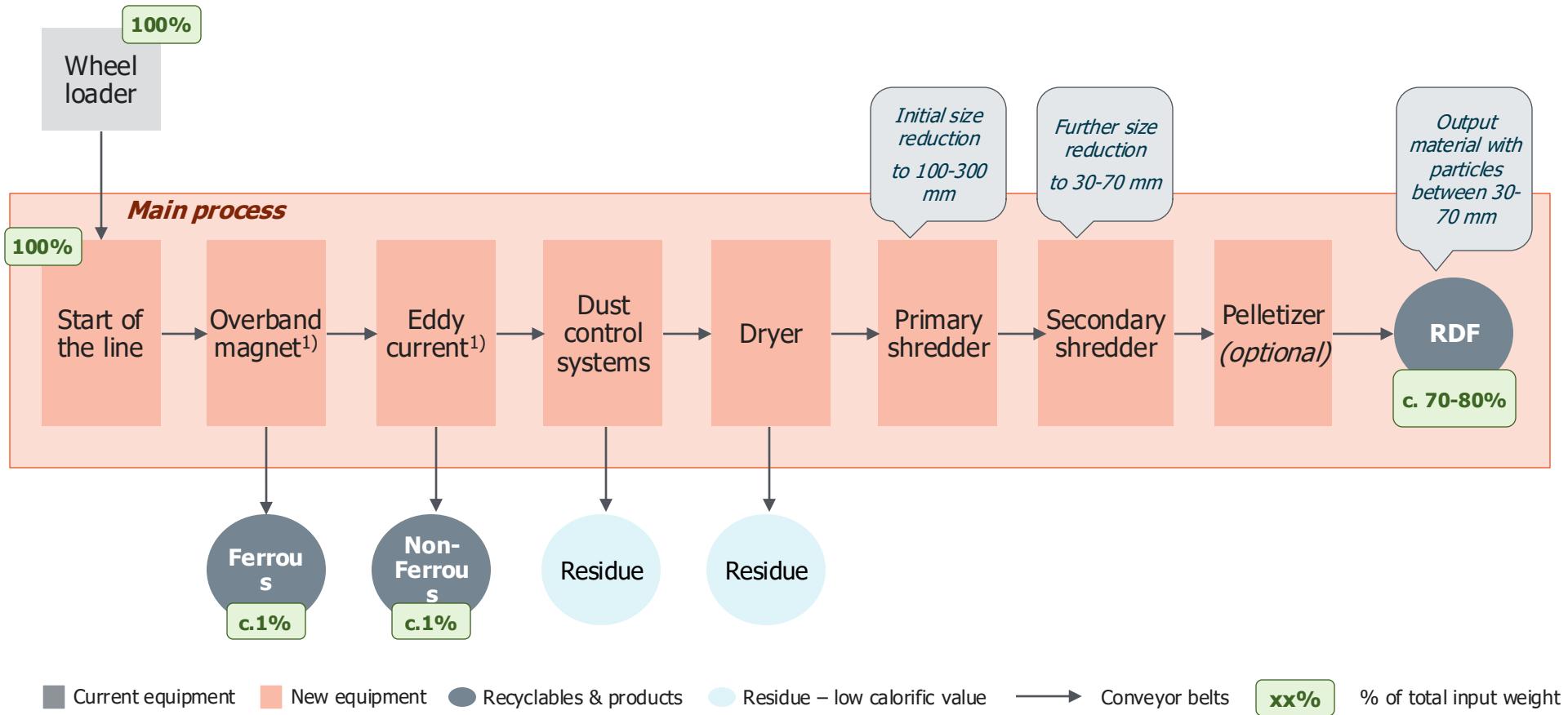
**M**  
**MACHINEX**

**BHS BulkHandling**  
SYSTEMS

- Opportunity to explore AI applications to upgrade the existing MRF, enhancing automation and maximizing the recovery of recyclables

# The RDF process consists of several key steps, each requiring specific equipment

Target RDF process flow diagram



## Key takeaways



- Waste enters the RDF line after MRF sorting, shredding, and screening
- Magnetic and eddy current separators remove ferrous and non-ferrous metals
- Dust control systems manage airborne particles for safety and compliance
- Shredders produce fine, uniform material
- Pelletizing is optional; RAK cement plants prefer non-pelletized RDF
- **c. 20-30% of waste is separated** during the process with some waste weight being reduced due to **inefficiencies** and **moisture vaporization**

1) Overband magnet and Eddy current might be removed in case the MRF also processes all the waste with these equipments

# The RDF would need a complete new set of machinery including a dryer, a primary shredder and a secondary shredder

## Potential new RDF equipment

Dryer



- RDF dryers reduce moisture in waste feedstock, enhancing calorific value for efficient combustion
- Using heated air or rotary systems, dryers prepare materials for energy recovery in applications like cement kilns

USD  
180 - 220 k

Primary shredder



- Breaks down large, bulky waste into smaller pieces for easier downstream processing
- Handles mixed waste streams, reducing volume for more efficient handling

USD  
300 - 400 k

Secondary shredder



- Refines shredded material into smaller, uniform pieces for RDF production
- Prepares material to meet specific particle size requirements for combustion or pelletizing

USD  
500 - 600 k

xx Price range (based on capacity of 19 Tons per hour)

# Moreover, the RDF new machinery such as dust control systems, an eddy current and a pelletizer

## Potential new RDF equipment

### Dust control systems



- Captures airborne particles during shredding and material handling to improve air quality
- Ensures worker safety and compliance with environmental regulations

USD  
40 - 50 k

### Eddy current



- Removes non-ferrous metals like aluminum and copper from the waste stream
- Enhances RDF purity while recovering valuable metals for recycling

USD  
100 - 130 k

### Pelletizer



- Compresses raw materials like plastic, wood, or metal into uniform, rounded pellets
- Pellets from a pelletizer are used as feedstock for further processing, like making new products, fuel, or for specialized uses
- It enhances material handling, shipping, and manufacturing and recycling efficiency

USD  
300 - 400 k

xx Price range (based on capacity of 19 Tons per hour)

# Lastly, the RDF new machinery such as a magnetic separator and conveyor belt

## Potential new RDF equipment

### Magnetic separator



- Extracts ferrous metals such as steel and iron using powerful magnets
- Reduces contamination and protects downstream equipment from damage

USD  
18 - 22 k

### Conveyor belts



- Transports waste materials efficiently between equipment in the RDF facility
- Ensures smooth workflow and consistent processing of mixed waste streams

USD  
80 - 120 k

xx

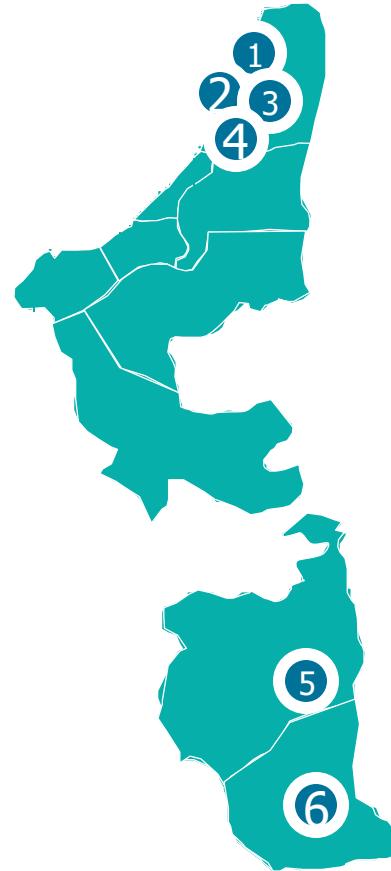
Price range (based on capacity of 19 Tons per hour)

# Offtake analysis



# RAK Cement sector shows strong potential as a key offtaker for RDF, with an estimated demand of ~ 0.5 to 1.4 m tons per year

Potential demand of RDF from RAK cement industry



Cement plant	Production [m ton/year]	Total energy demand [m GJ/year]	RDF demand potential [k ton/year]		
			10%	20%	30%
1 RAK White Cement	0.61	3.0	20	40	59
2 Gulf Cement	3.8	18.8	125	251	376
3 RAK Cement	1.0	5.0	33	66	99
4 Union Cement	4.6	22.8	152	304	455
5 Star Cement	2.4	11.9	79	158	238
6 Pioneer Cement	1.7	8.4	56	112	168

## Key observations

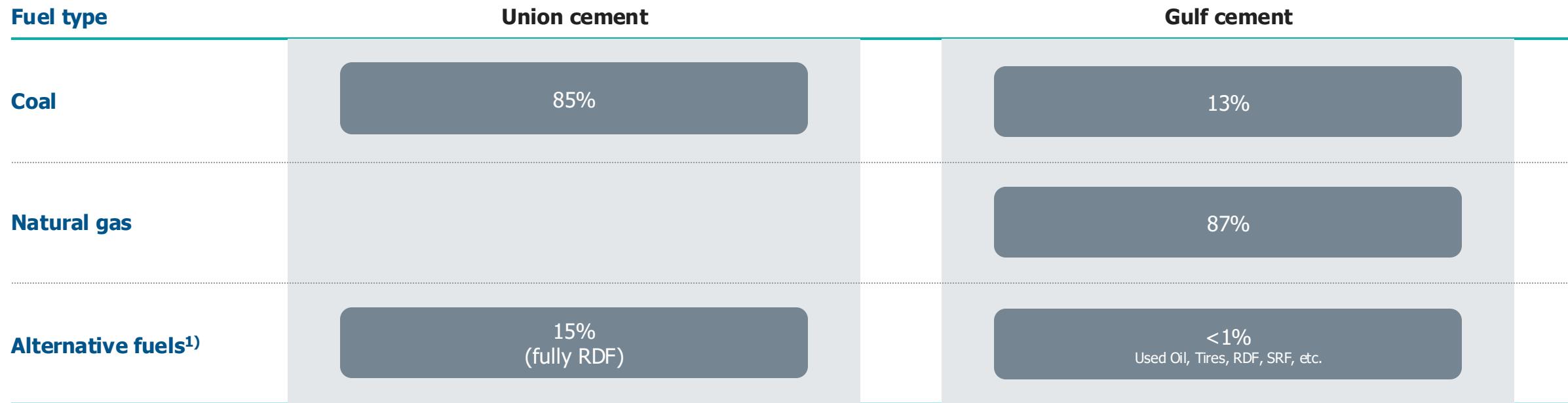


- UAE federal government encourages manufacturers to use 10% alternative fuels
- Estimated RDF demand in RAK's cement industry ranges from 0.5 to 1.4 m tons per year, potentially generating annual AED 55-155 m<sup>1)</sup> in additional revenue
- Cement sector demonstrates strong potential as a key offtaker for RDF

1) Estimation based on AED 110 / ton

# Cement plants in RAK such as Union cement and Gulf cement trying to use a more sustainable energy mix - RDF supply could help them with their transition

Type of fuel used by RAK cement companies in production process, 2024



## Comments

- Fossil fuels are the **dominant fuel** type among RAK cement companies, mainly due to its availability and **competitive price**
- Union Cement has infrastructure for RDF usage and already uses RDF in its fuel mix
- Gulf cement is already making efforts towards sustainability by using **gas as a more sustainable alternative to coal**
- As observed globally, fuel used for cement production can be **substituted up to 80%**, therefore **cement factories in RAK have a large substitution potential by using RDF**



# The final RDF product should adhere to strict technical specifications, therefore the RDF facility design should cater for achieving these product specifications

RDF specifications – Cement factories

	<b>Gulf cement – RAK specs</b>	<b>Sharjah cement factory</b>
<b>Maximum moisture level</b>	9%	10%
<b>Maximum sulfur level</b>	1%	0.3%
<b>Maximum chlorine level</b>	1%	0.7%
<b>Size (mm)</b>	5 - 20 mm	25 - 30
<b>Minimum calorific value (Kcal/KG)</b>	4,000	5,000
<b>Density (kg/m<sup>3</sup>)</b>	250 - 300	n/a

# Gulf cement and Union cement should be prioritized for establishing offtake agreements based on their high offtake capacity and interest

## Offtake analysis



## Key observations



- Gulf Cement Company is ready to integrate 600 tons of RDF per day into its energy mix to enhance sustainability
- Gulf Cement has approached PSD to discuss RDF offtake possibilities

1) Based on 10% RDF substitution rate of total energy demand

# RDF is being sold for a price of c. 100 – 300 per ton

Benchmark RDF offtake price

Company	Country /region	Offtake price [AED per ton]
EU	EU benchmark	100 - 300
		
Beeah	Sharjah	110
		
Innovative solution	Riyadh	115 - 140
		
Ecaru	Cairo	165
		

## Key observations

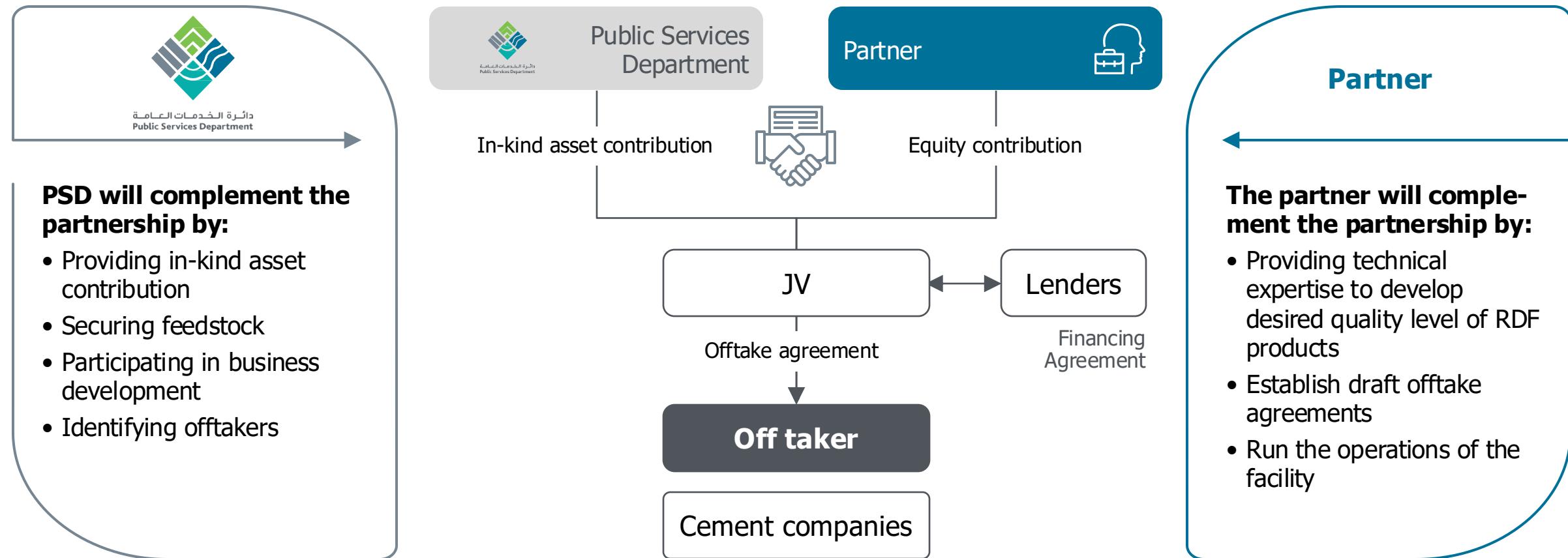


- Offtake prices in the range between 100 -300 AED per ton

# Business model & success factors

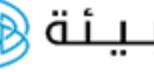
# A Joint Venture could act as the ideal partnership model for establishing the new RDF facility, a partner could bring in the technical expertise PSD requires

## Potential JV model



# PSD could approach one of the following companies as a potential partner – Besix/Kova and Beeah have proven UAE expertise in setting up RDF facilities

Potential partners

Company name	RDF plant operations expertise	UAE RDF expertise	Revenues ['22, AED bn]
 BESIX 	✓	✓	13
 BEEAH 	✓	✓	1
 VEOLIA	✓	✗	117
 REMONDIS® WORKING FOR THE FUTURE	✓	✗	47
 SUEZ	✓	✗	28
 RE Sustainability	✓	✗	16
 URBASER making circularity real	✓	✗	8
 SIRC	✓	✗	NA

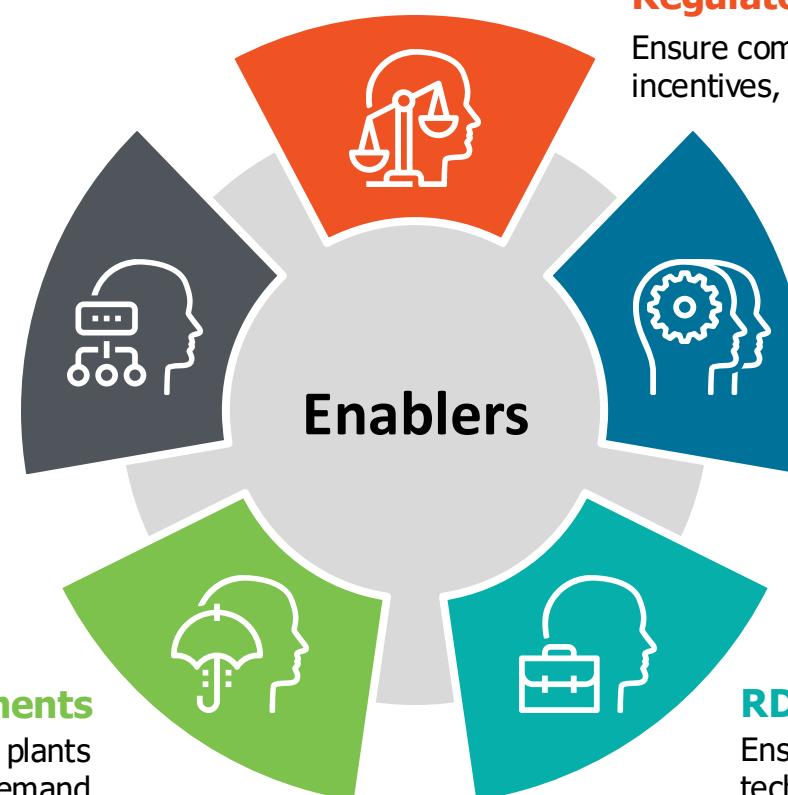
## Key observations



- Out of these potential partners, Beeah and Besix/ Kova are the only companies with expertise in the UAE market

# The following 5 enablers are key for achieving a successful JV partnership for setting up the RDF facility

Required enablers for setting up an RDF facility



## Market positioning and stakeholder engagement

Drive RDF market acceptance, communicate value to offtakers, and align with community stakeholders

## Offtake agreements

Establish long-term offtake agreements with cement plants for consistent demand

## Regulatory and policy alignment

Ensure compliance with environmental regulations, secure incentives, and promote policies supporting RDF adoption

## Partner selection

Collaborate with an experienced partner possessing strong expertise in RDF production

## RDF product specifications

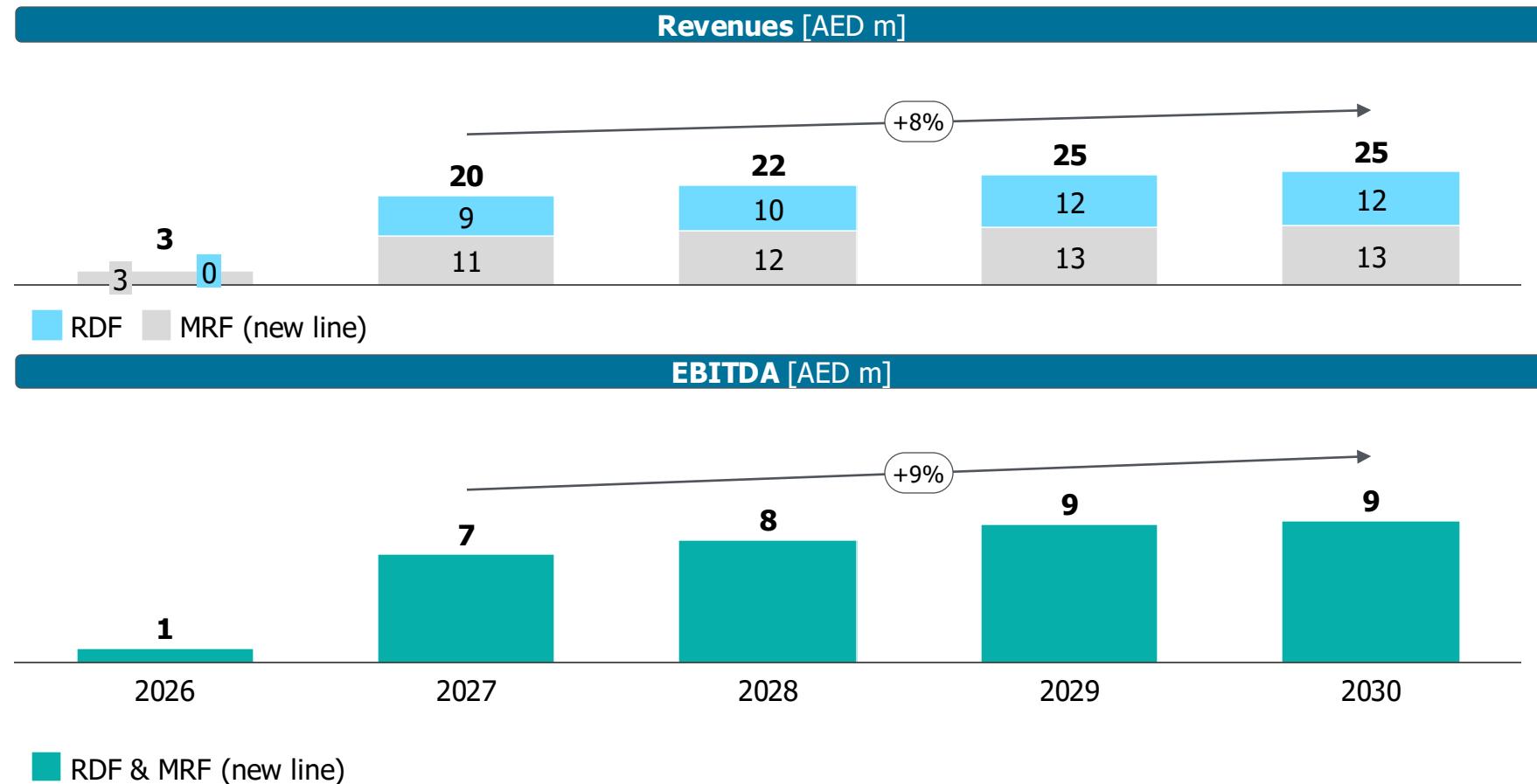
Ensure RDF production meets the specific quality and technical standards required by cement plants

# Financials & risks



# The new MRF and RDF plant are expected to jointly make AED 25 m of revenues in 2030, with EBITDA of AED 9 m

Key financials ['26-'30, AED k]



Please note that 2026 is the first operational year of the RDF plant; 1) Based on current MRF baseline recyclable volume c. 19 k tons (incl. 13 k ton cardboard trading), 15 k tons from new line 86 k ton RDF and c. 260 k ton of MSW collected; 2) Based on a plant with a capacity of 130 k tons p.a. and a utilization of 95% in 2030, with a 70% recovery rate of RDF

## Key metrics

Project IRR [%]	5%
Landfill diversion	c. 32% <sup>1)</sup>
RDF offtake price [AED/ton]	120
RDF volume [k tons, '30]	86 <sup>1)</sup>
Avg. recyclables price [AED/ton]	720
New MRF recyclables volume [k tons, '30]	15
New MRF CAPEX [AED m]	63
RDF CAPEX [AED m]	20

# The following CAPEX assumptions have been used in the financial model for the MRF and the RDF, leading to a total of c. 83 m AED

## Main CAPEX assumptions

New MRF assumptions	
Cost type	Cost [AED]
<b>Equipment</b>	30,000,000
General equipment and conveyors	16,500,000
Additional automation equipment	5,500,000
Wheel loaders and bailers	4,000,000
System engineering costs	2,500,000
Other	1,500,000
<b>Civil works</b>	20,000,000
<b>Engineering &amp; other costs</b>	5,000,000
<b>Contingency (15% of subtotal capex)</b>	8,250,000
<b>Total new MRF CAPEX</b>	<b>63,250,000</b>
<b>MRF relocation assumptions</b>	
<i>To be assessed</i>	

RDF assumptions	
Cost type	Cost [AED]
<b>Civil works</b>	6,670,000
<b>Truck</b>	2,820,000
<b>Wheel loader</b>	2,680,000
<b>Secondary shredder</b>	2,000,000
<b>Primary shredder</b>	1,320,000
<b>Dryer</b>	800,000
<b>Eddy current separator</b>	500,000
<b>Conveyors</b>	420,000
<b>Dust control systems</b>	160,000
<b>Magnetic separator</b>	70,000
<b>Contingency (15% of subtotal capex)</b>	2,616,000
<b>Total RDF CAPEX</b>	<b>20,056,000</b>

## **B.2.2.2. Set-up a CDW recycling plant**

# A fixed CDW facility with a capacity of ~ 700 k tons per year can be established in RAK to generate potential revenue of AED 19 m annually

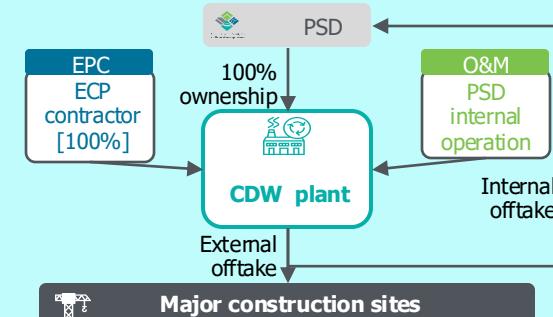
## CDW recycling plant overview



### Financials & impact

CAPEX	AED 32.5 m
IRR	18%
Revenues	AED 19 m p.a.
Gate fee	Clean: AED 10 Mixed: AED 20
CDW diversion	60-70%

### Partnership & operating model



### Potential Partners

No operational partner needed

### Key success factors

- 1 Implement gate fee to self-sustainable operation of the facility
- 2 Apply GPS and monitoring to ensure constant flow of feed stock
- 3 Impose minimum recycled content to secure the offtake market

xx% % of total waste volume processed by the CDW facility

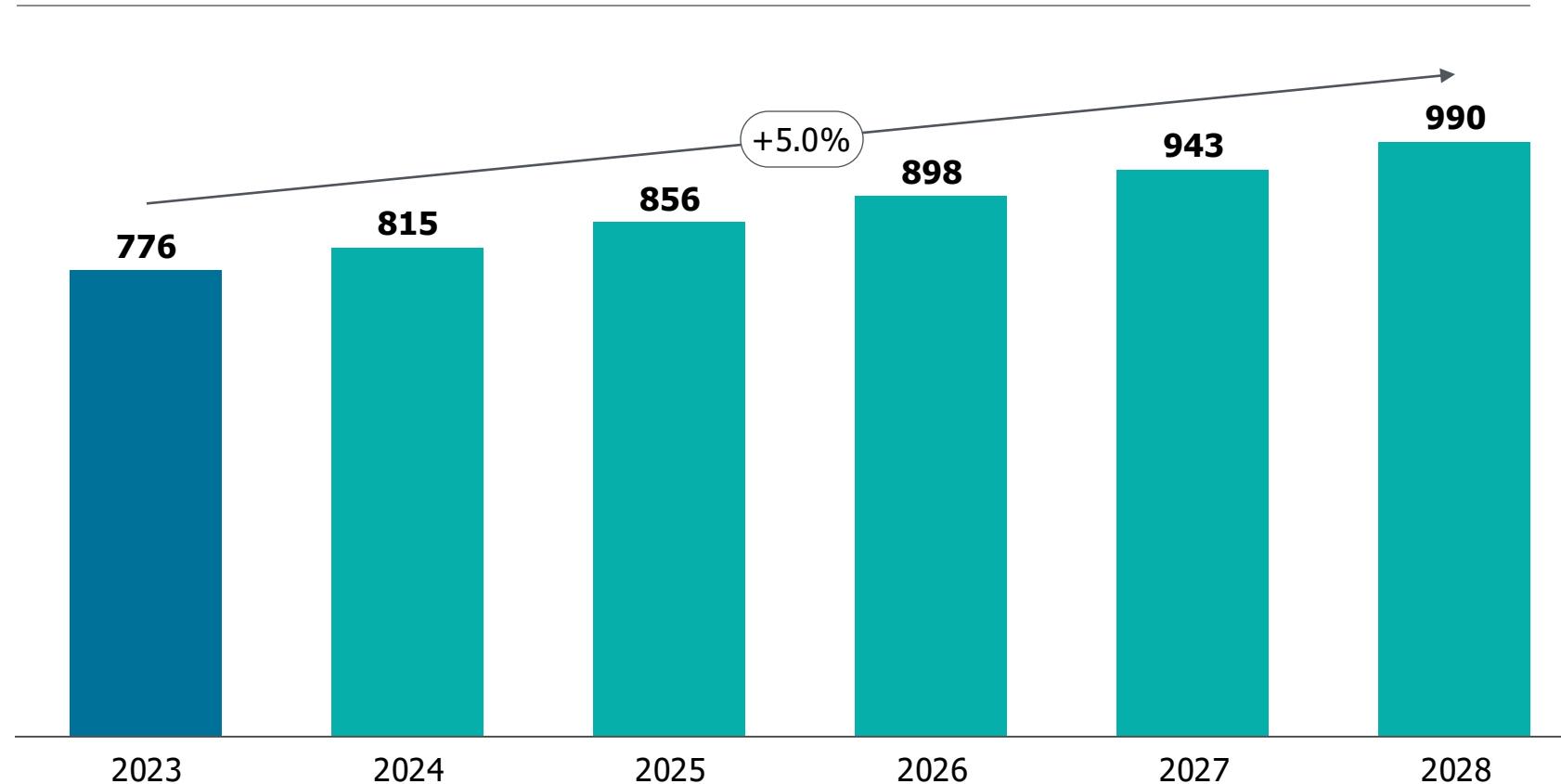
# Feedstock strategy



# Tourism projects in RAK are driving regional CDW generation, with waste expected to grow at a 5% CAGR, reaching ~990 tons p.a. by 2028

## RAK CDW overview

### RAK CDW generation and forecast 2023-2028 [k tons p.a.]



### Key takeaways

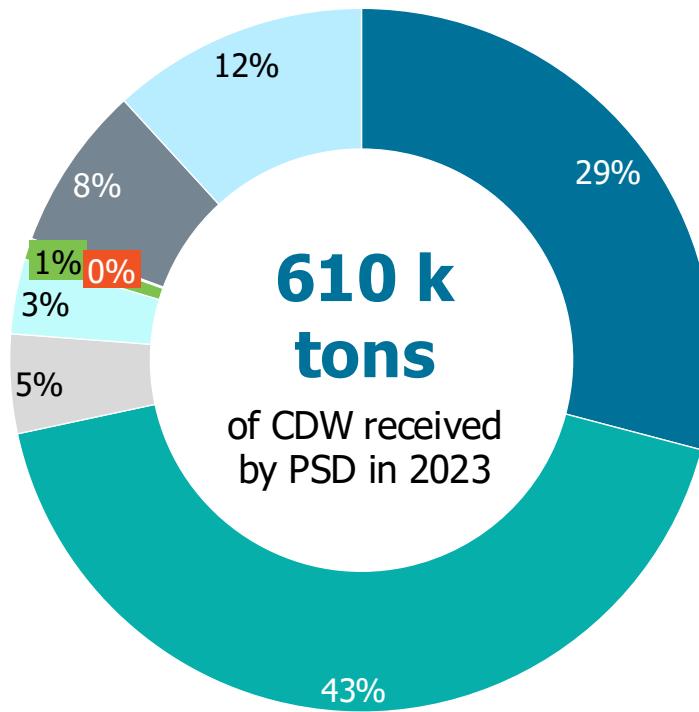


- In 2023, RAK generated ~780 k tons of construction and demolition waste
- With ambition of tourism sector development, **tourism destination construction projects** are expected, leading the growth of CDW generation
- CDW in RAK is expected to grow at a **CAGR of 5%** and **reach 990 k tons / year**

# Majority of CDW received today can be directly recycled through sorting and crushing, creating economic value and supporting waste diversion efforts

## RAK CDW composition

### RAK CDW composition [%]



### Material and treatment method

<b>Sand</b>	<ul style="list-style-type: none"><li>• Screening and cleaning</li><li>• Proceed sand reused in mortar</li></ul>	<b>Asphalt</b>	<ul style="list-style-type: none"><li>• Cold/hot recycling to be used in new asphalt mixtures</li></ul>
<b>CD mineral<sup>1)</sup></b>	<ul style="list-style-type: none"><li>• Sorting and crushing into different size of aggregates</li></ul>	<b>Concrete</b>	<ul style="list-style-type: none"><li>• Sorting and crushing into different size of RCA</li></ul>
<b>Marble</b>	<ul style="list-style-type: none"><li>• Sorting and crushing into marble dust</li></ul>	<b>Interlock</b>	<ul style="list-style-type: none"><li>• Cleaning and reusing</li><li>• Crushing into aggregates</li></ul>
<b>Gypsum</b>	<ul style="list-style-type: none"><li>• Sorting and crushing</li><li>• Grinding and sieving</li></ul>	<b>Mixed</b>	<ul style="list-style-type: none"><li>• Process depends on the material</li><li>• Sorting is the first step</li></ul>

### Key observations



- Currently, **all CDW is landfilled**, resulting in a loss of valuable materials
- PSD receives 7 types of CDW,
- **Sand** is the second-largest CDW type in RAK and requires cleaning, but due to geographical factors, **recycling it is less economically viable**
- ~ 65% of CDW received can be directly processed by **sorting and crushing facilities** to produce **recycled aggregates**

1) Gravel included

# Technology and operation

# Different technologies are being used for CDW management, mostly during the crushing/ sorting and treatment steps of the value chain

## CDW treatment technology overview

### Sorting & crushing



Focus of RAK



- Involving the use of technologies to **crush and sort** the material into categories
- Output can be used as a **filling, leveling and subbase** for construction



#### Technology involved

- Air classification
- Magnetic separation
- Screening
- Crushing

### Treatment & recycling



- Involving the use of **advanced dry recovery of material and sand washing**
- Output can be used as a raw material for **recycled concrete and asphalt**

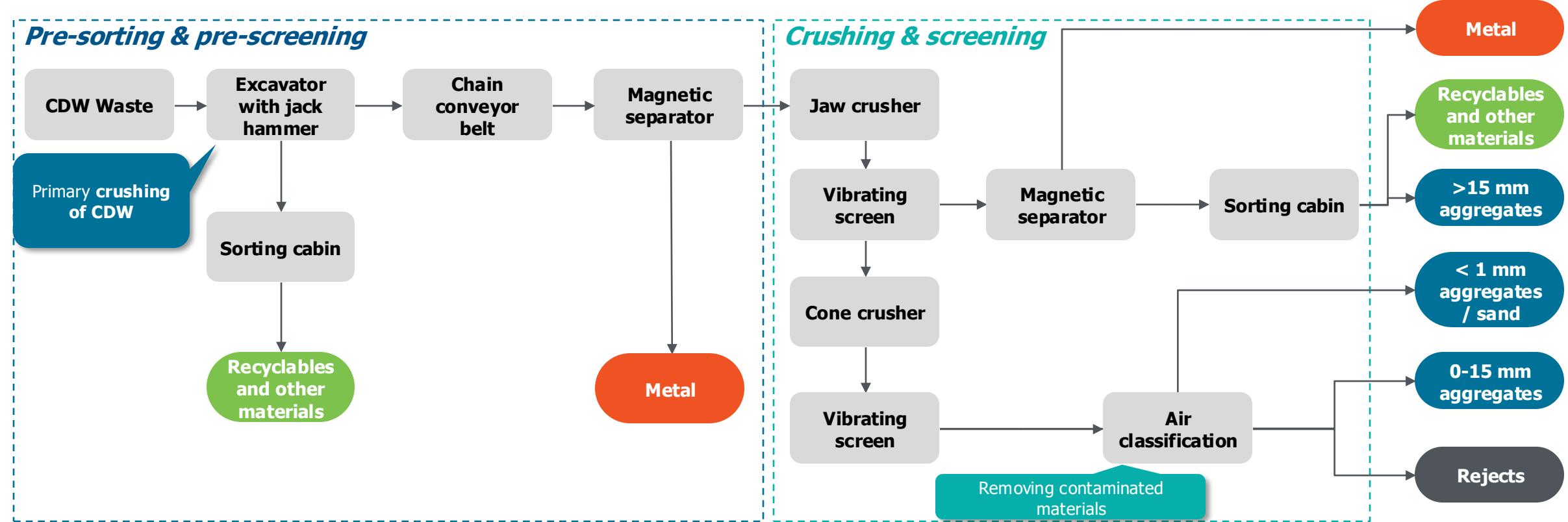


#### Technology involved

- Advanced dry recovery
- Sand washing system
- Thermal treatment

# A CDW recycling facility setup includes vibrating screens to separate aggregates and crushers to further process them into the desired sizes

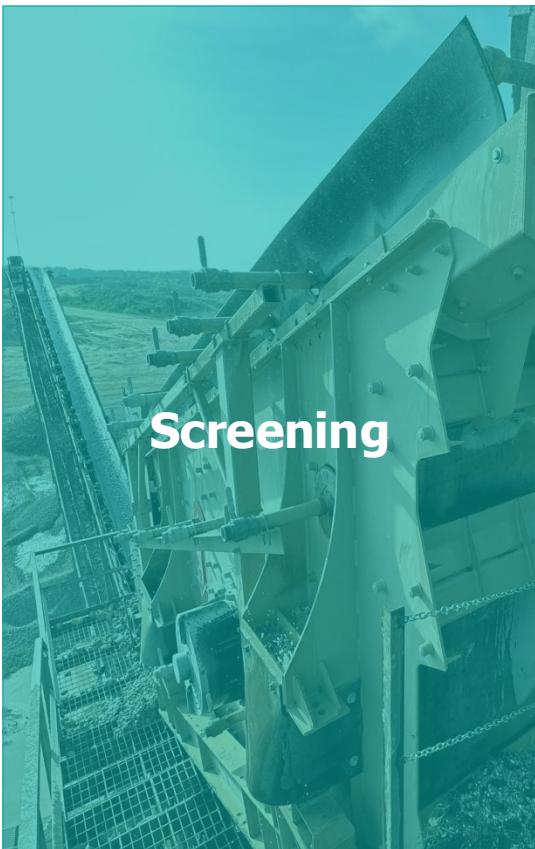
CDW treatment flow chart



**Crushing and screening equipment** are vital to a CDW recycling plant, with the plant design largely depending on the **expected output**

# Screen technologies are placed before, during, and after the crushing process to separate and classify final aggregates by size

## Overview of screening technologies



Vibrating screen



- Screening machine used to classify and sort materials by size
- It features a flat or inclined screen deck that vibrates, causing materials to move across the screen and separate according to particle size
- It is placed after every crushing step to screen and classify materials

AED 300 – 500 k

Air classification



- Air classifiers are used to separate fine particles from processed materials
- It features a compact design with a closed internal air circuit, available in both single and double rotor configurations
- It is typically positioned at the end of CDW recycling process to separate aggregates and rejects

AED 800 – 1,000 k

Magnetic separator

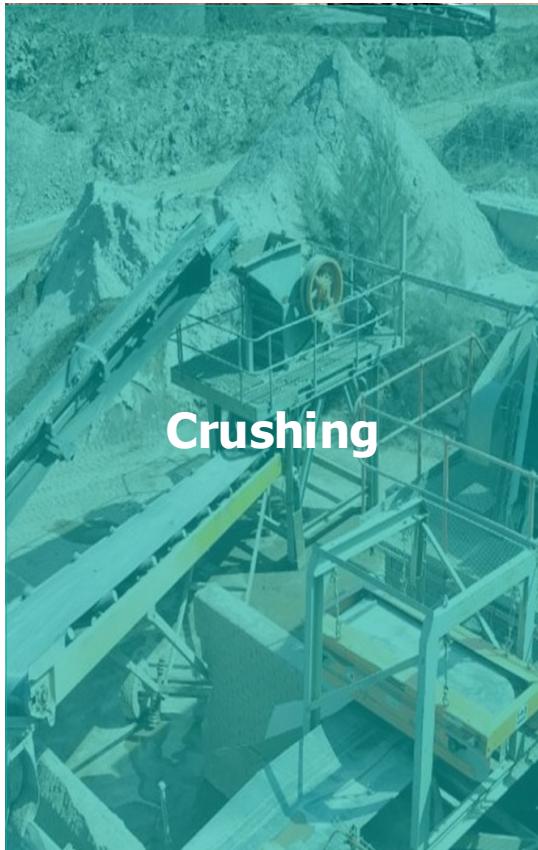


- A rotating magnetic drum or belt
- It utilizes a strong magnetic field to capture ferrous metals
- It is usually used during the pre-sorting and after screening process to separate metal materials from CDWs and aggregates

AED 80 – 100 k

# Crushers are essential in the CDW recycling process, breaking down mineral waste into reusable aggregates and producing the final product

## Overview of crushing technologies



Jaw crusher



- Crusher used in CDW recycling to break down large, hard materials
- It has two jaws (one fixed, one movable) that create a crushing motion, breaking the material when it is squeezed between the jaws
- It is typically the first crushing stage in CDW processing, preparing large debris for further crushing or screening

AED 700 – 900 k

Cone Crusher

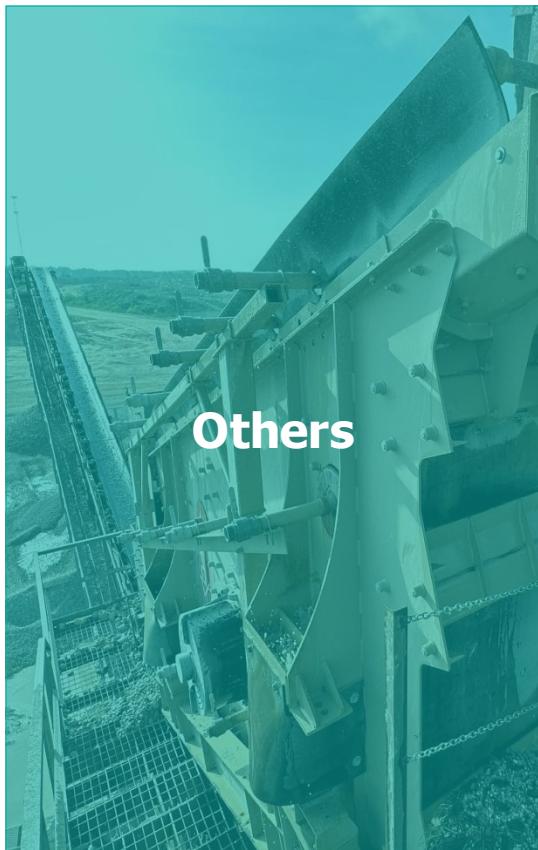


- Conical shape crusher with a central rotating shaft surrounded by a mantle
- It features a rotating cone (mantle) that crushes materials against a concave surface, using compressive force to break the material into finer particles
- It is typically used after a primary crusher to achieve finer crushing and prepare materials for final processing or use

AED 400 – 700 k

# Two types of conveyor belt efficiently transport CDW between different processing units, streamlining the recycling workflow

## Overview of other technologies



Chain conveyor belt



- A continuous metal belt mounted on chains, which move over sprockets
- It is designed for heavy-duty material handling with a durable belt reinforced by chains
- It is placed at the feeding stage of CDW to carry uncrushed and heavy weight waste

AED 400 – 600 k

Rubber conveyor belt



- A long, continuous belt made from durable rubber material
- It is designed with a flexible, wear-resistant belt and a roller system to ensure smooth and efficient material transport
- Typically used throughout the CDW recycling process to ensure the movement of the aggregates (20-30 belts needed)

AED ~ 5,000 k<sup>1)</sup>

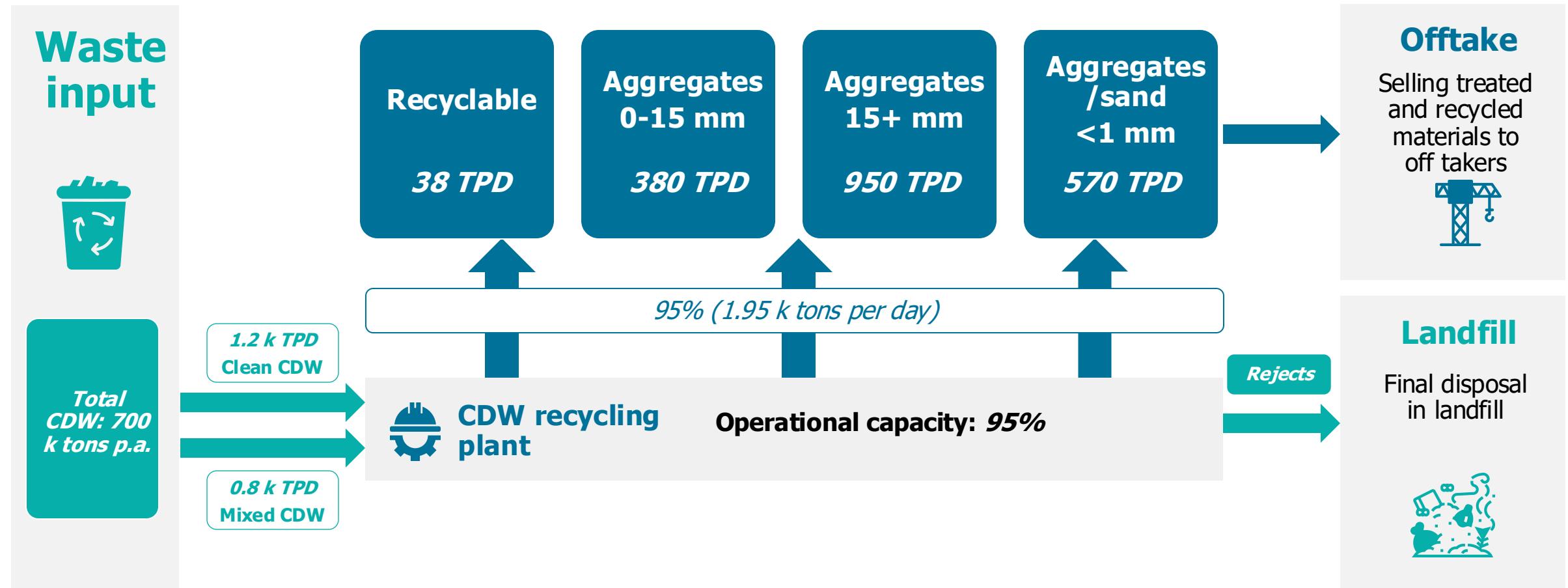
1) For entire process

# Offtake analysis



# RAK CDW recycling facility will process 2 k TPD of CDW, generating approximately 1.9 k TPD of recyclable aggregates for further offtake

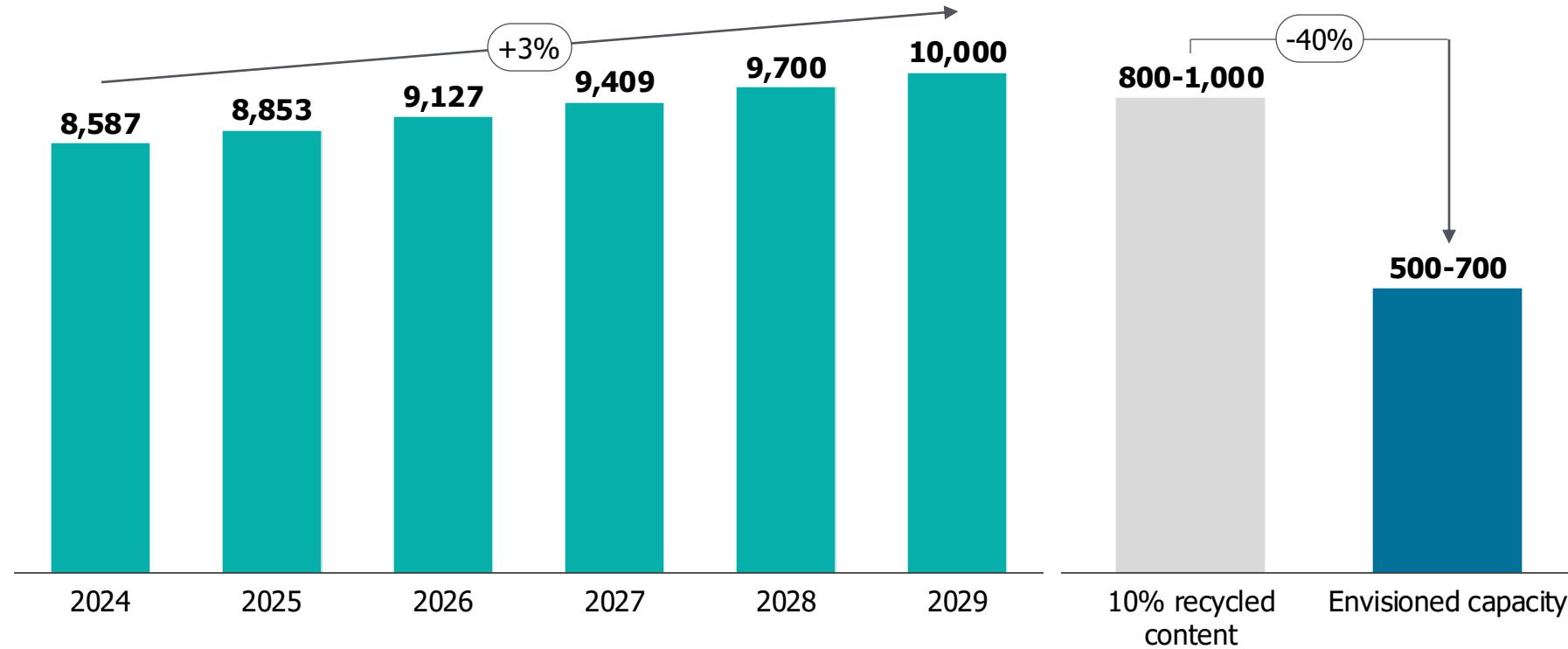
Overview of output and by product of CDW recycling facility



# With regulatory support, there is sufficient offtake market in RAK for the CDW facility to operate sustainably

Overview of RAK CDW aggregates offtake market

## RAK construction aggregate market size 2024-2029 [k tons p.a.] RCA offtake potential [k tons p.a.]



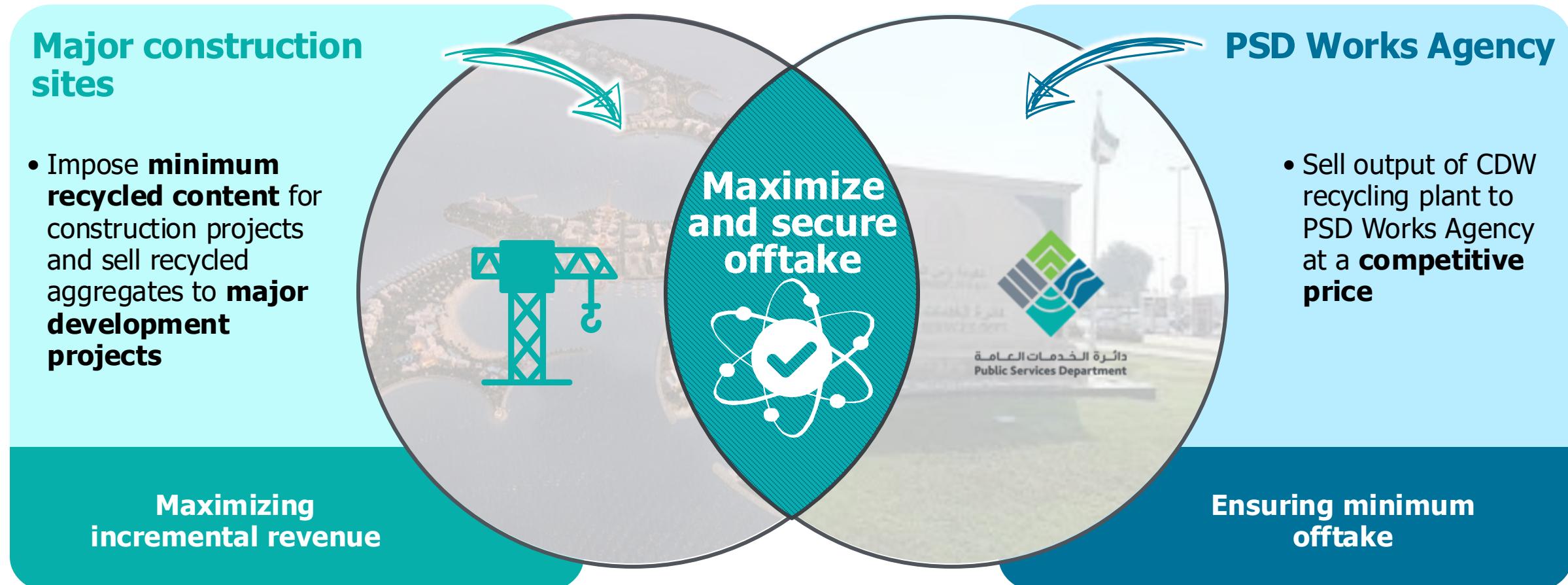
### Key assumptions



- UAE aggregate market size projected to reach USD 4 bn by 2029
- Aggregate market growth corresponds with the construction industry's CAGR of 3%
- RAK's share of the UAE aggregate market is estimated based on its GDP contribution from the construction sector
- Average aggregate price per ton: AED 18-22

# PSD can sell recycled materials to major construction sites and the Construction Department, maximizing revenue and ensuring minimum offtake

Overview of CDW recycling output off takers



# PSD can sell recycled materials to major construction sites and the Construction Department, maximizing revenue and ensuring minimum offtake

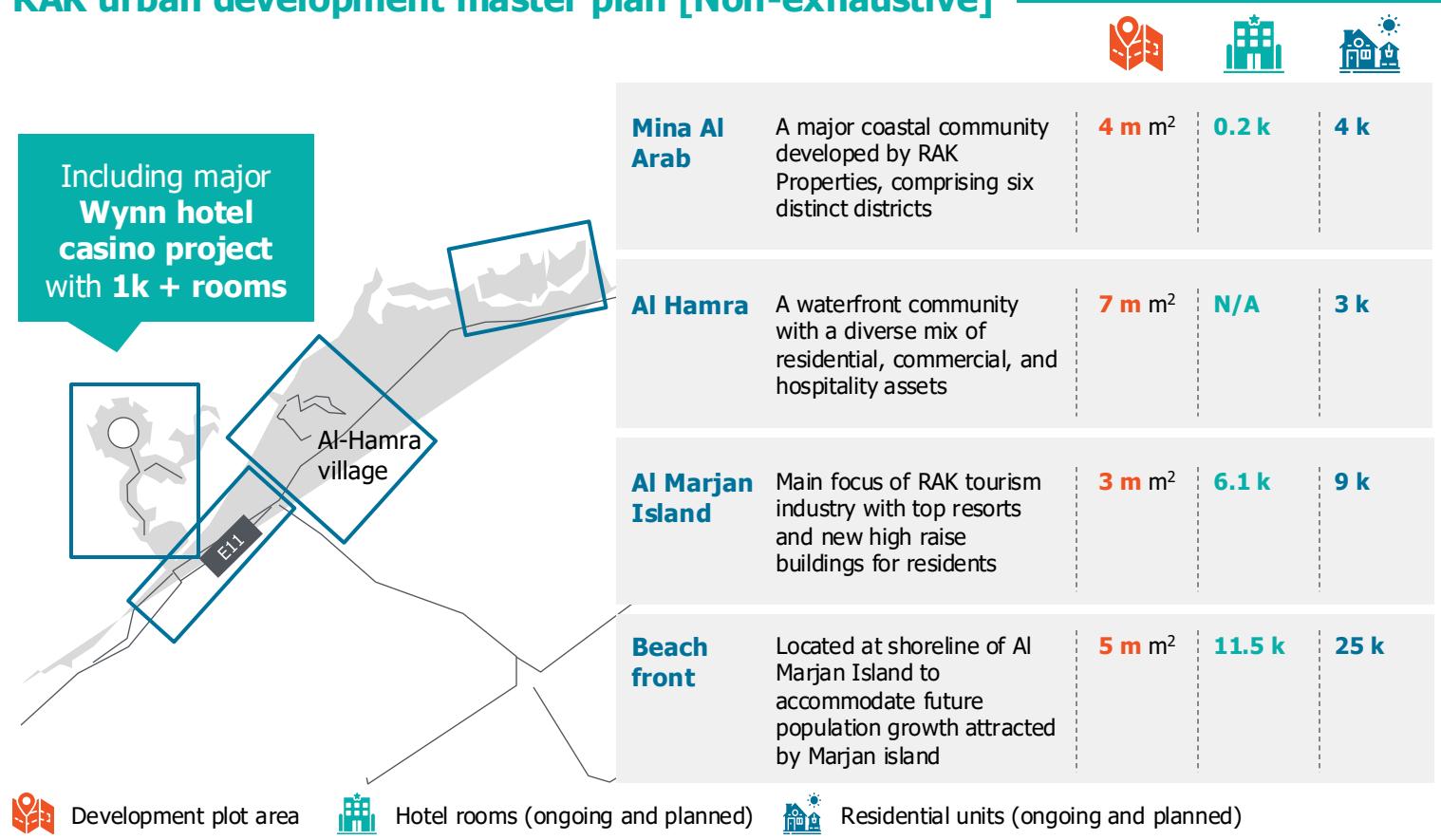
Overview of CDW recycling output off takers



# RAK's urban development plans create significant offtake potential for CDW RCA, which can be used in as backfilling or raw material for concrete

Major construction site offtake analysis

## RAK urban development master plan [Non-exhaustive]



## Off taking CDW output

### 0-15 mm aggregates

Sold to ready-mix concrete company as the raw material of concrete

### Sand and 15+ mm aggregates

Directly sold to construction site as the backfilling materials

## Key insights

- RAK's urban development plans focus on four main areas to accommodate future population growth
- ~ 20 m<sup>2</sup> of development is underway, with ~ 18 k hotel rooms and ~ 40 k residential units planned or under construction
- All three aggregate types can be used for concrete and backfilling in these projects

# PSD can sell recycled materials to major construction sites and the Construction Department, maximizing revenue and ensuring minimum offtake

Overview of CDW recycling output off takers



# RCA from the CDW facility can be used by PSD Works Agency for bedding, backfilling, and landscaping at a reduced cost

## PSD Project Development Department offtake analysis

### PSD Works Agency and rationale

- PSD Works Agency oversees public infrastructure development in RAK, including roads, sewage networks, and public landscaping
- Recycled aggregates can be sold to PSD Works at a more competitive price than virgin materials, fostering internal synergies while enhancing a sustainable brand image

### Usage of RCA by Works Agency

#### Utility trenches

RCA to be used as bedding and surrounding material for sewage network and utility lines



#### Landscaping

RCA can be used to construct walkways and garden bed edging



#### General backfilling

RCA is used for embankments and as backfill for retaining walls and bridge abutments



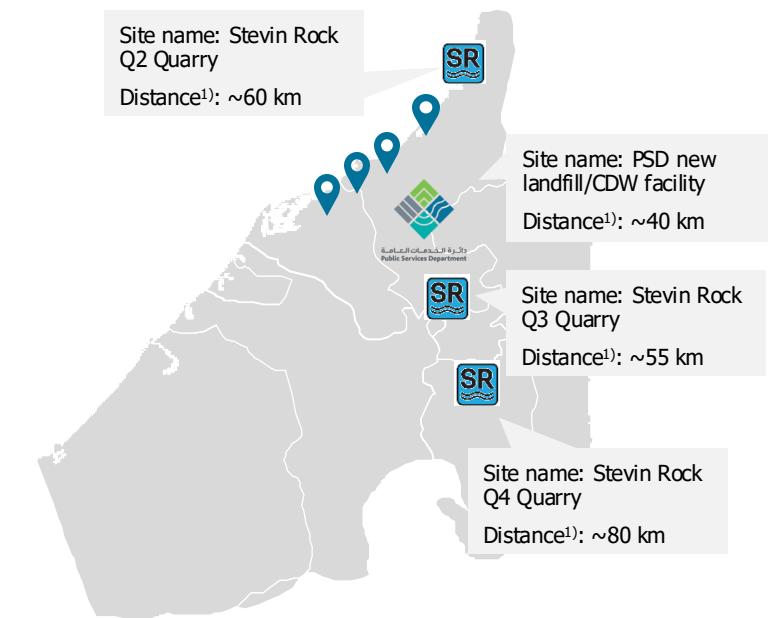
#### Road

RCA can be used as a road subbase but is not preferred due to its lower strength under heavy traffic

Not applicable

### Aggregate supply location and associated costs [AED/ton]

- PSD Works Agency and contractors source aggregates from **Stevin Rock**, the region's largest supplier
- Transportation costs** significantly impact the overall raw material cost



#### Current aggregates

Price: 9-10

Transportation cost: 10-11

#### RCA from facility

Price: 8

Transportation cost<sup>2)</sup>:  
6-7

~30% cost saving for PSD

Main development areas



PSD CDW facility location



Stevin Rock sites

1) To main development areas; 2) Estimated based on the transportation distance

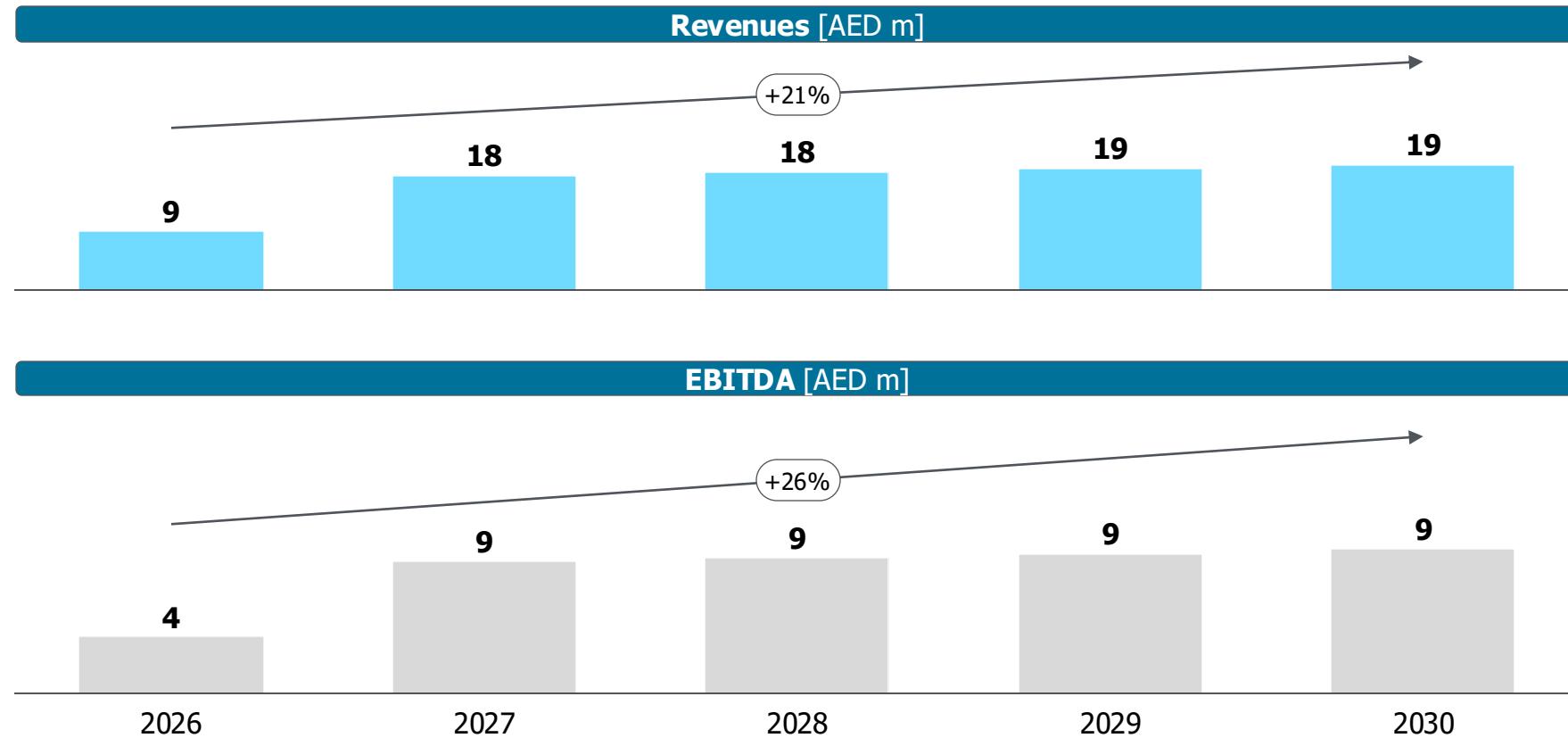
# Financial and risks



# The CDW recycling plant is expected to make ~ AED 19 m of revenues in 2030, with EBITDA of ~ AED 9 m

Key financials ['26-'30, AED m]

Project duration: 10 years



Note: 2026 is the first operational year of the CDW plant

1) Average price of aggregates 0-15 (AED 10/t), aggregates 15+, (AED 8/t), sand and <0 mm aggregates (AED 5/t)

## Key metrics

Project IRR  
[%]

18%

Material  
offtake price<sup>1)</sup>  
[AED]

14

CDW  
recovered  
materials  
volume  
[k tons p.a.]

630

Landfill  
diversion

61%

Cumulative  
CAPEX  
[AED m]

c. 33

# The following CAPEX and OPEX assumptions have been used in the financial model

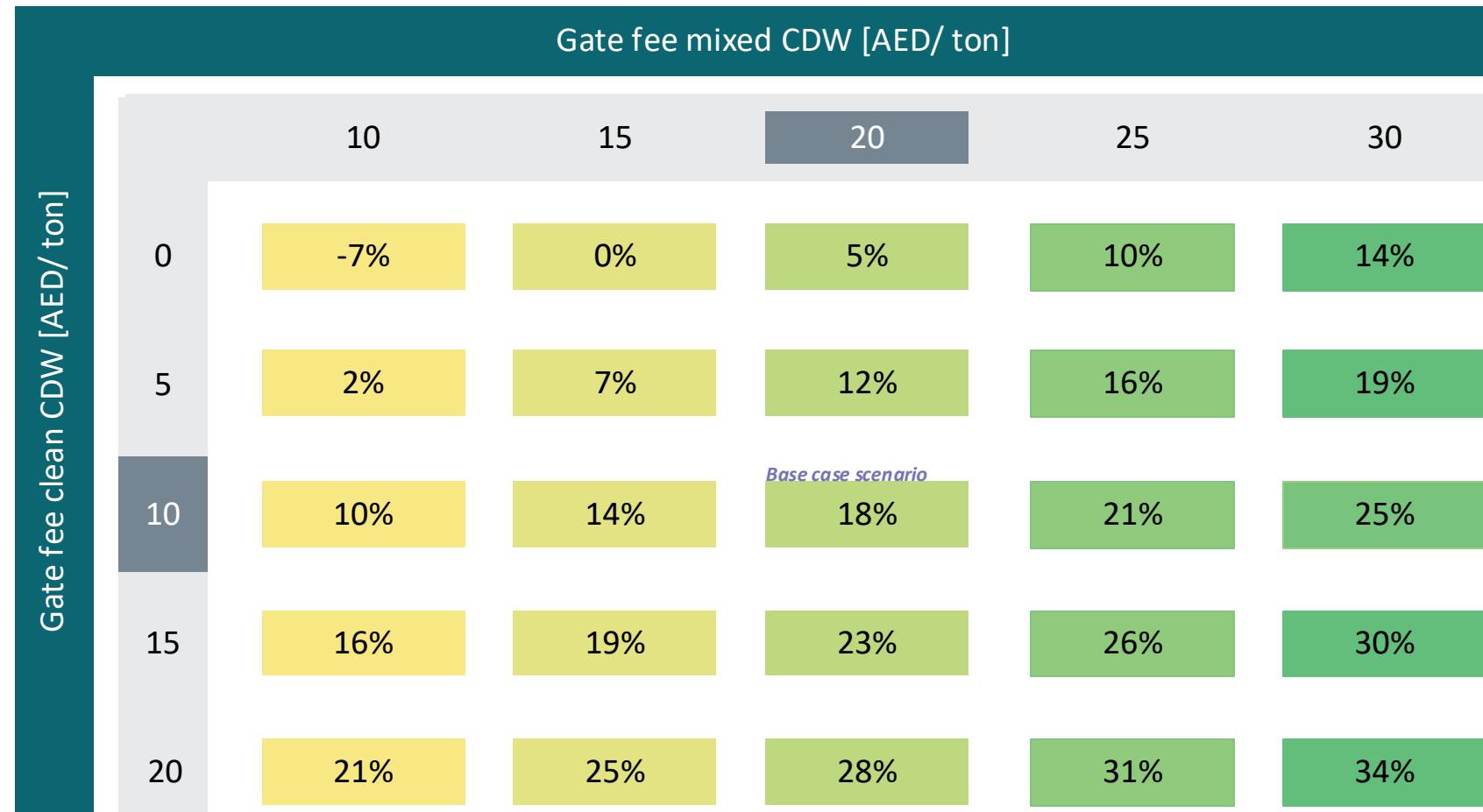
Main CAPEX and OPEX assumptions

CAPEX assumptions		
Machine	Quantity [#]	Purchase cost [AED]
Chain conveyor	2	500,000
Magnetic separator	4	100,000
Jaw crusher	2	900,000
Cone crusher	2	650,000
Vibrating screener	2	400,000
Vibrating screener 2	2	450,000
Rubber conveyor	1	5,000,000
Excavator	3	1,000,000
Wheel loader	2	1,000,000
Truck	2	700,000
Civil works	1	10,000,000
Air classifier	2	1,000,000
CAPEX contingency	10%	2,960,000

OPEX assumptions	
Assumption category	Assumption
<b>Employee</b>	
FTE required	43
Average annual CTC	53,000 AED
<b>Fuel</b>	
Fuel charge per liter	3.5 AED
<b>Utilities</b>	
Monthly FEWA	10,000 AED
Monthly Etisalat	3,000 AED
<b>Other OPEX</b>	
Maintenance	0-9% of total revenue
G&A	4-6% of total revenue
OPEX contingency	15% of total other OPEX

# The IRR for the CDW facility highly depends on the gate fee of clean and mixed CDW

CDW recycling facility sensitivity analysis [% of IRR ]



## Key takeaways

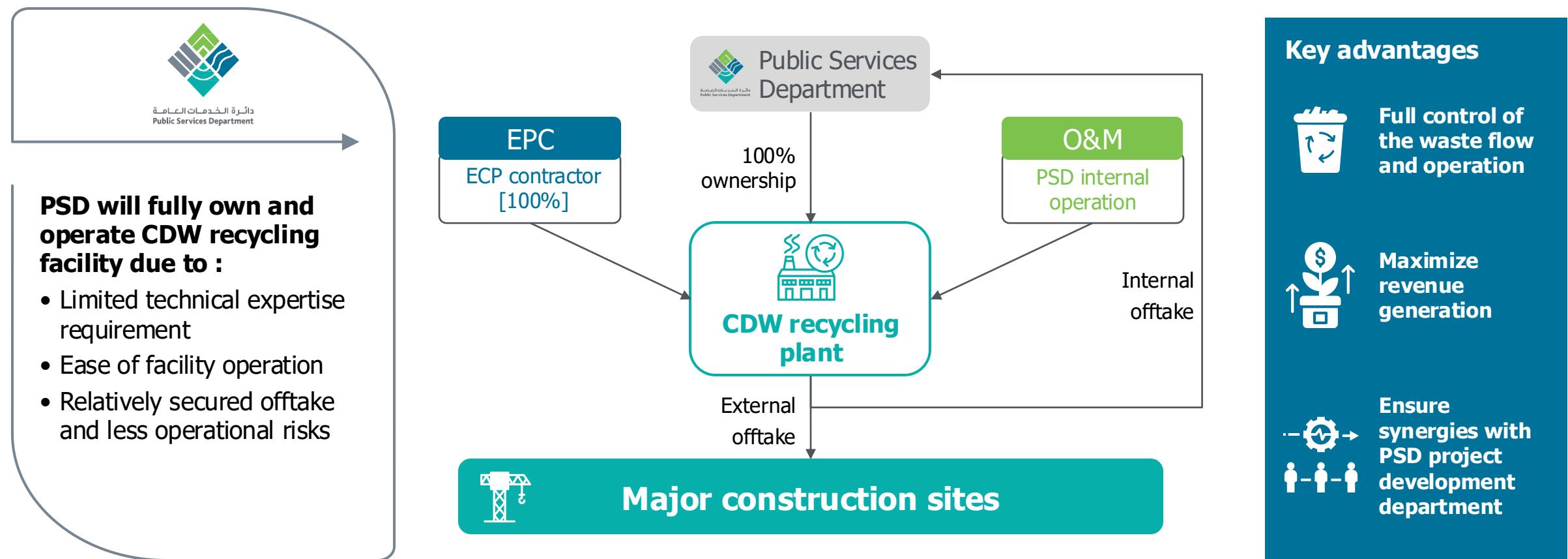


- The IRR is driven mostly by the change in gate fee on mixed and clean CDW
- In the base case scenario with a mixed CDW gate fee of 20 AED/ ton and clean CDW of 10 AED/ ton the expected IRR is 18%

# Business model & success factors

# Less technical expertise requirement, ease of operation, and less operational risks make inhouse operation an ideal business model for CDW plant

## Potential inhouse model



# Controlling and securing waste inflow and offtake are crucial to ensuring the financial viability of the CDW recycling facility

Overview of key success factor and enablers of CDW recycling plant

## 1 Self-sustainable operation

- Ensuring the CDW plant achieves financial viability without incurring losses
- Continuous operation without dependence on additional PSD funding



Implement **gate fee** to maximize financial viability

## 2 Constant feedstock inflow

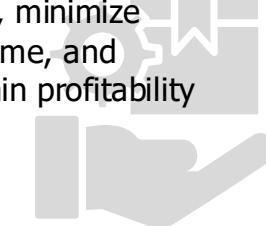
- Consistent supply of CDW material is crucial for ensuring economies of scale, minimizing idle times, and sustaining production efficiency



Enhance monitoring and apply **GPS** to waste transporter

## 3 Efficient facility operation

- Efficient operation of both machinery and personnel directly impacts cost control and productivity, enabling the facility to maximize output quality, minimize downtime, and maintain profitability



Conduct **supplier evaluation** and personnel **training**

## 4 Secured offtake

- Reliable offtake agreements guarantee that the recycled materials have a stable market, generating predictable revenue streams that support ongoing operations



Implement **minimum recycled content requirement**

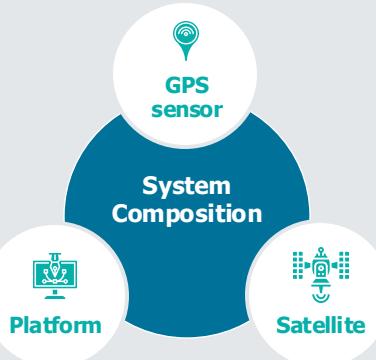
■ Key Enabler

# By implementing a geofencing system and requiring generators to install GPS sensors, PSD can monitor and reduce illegal dumping activities

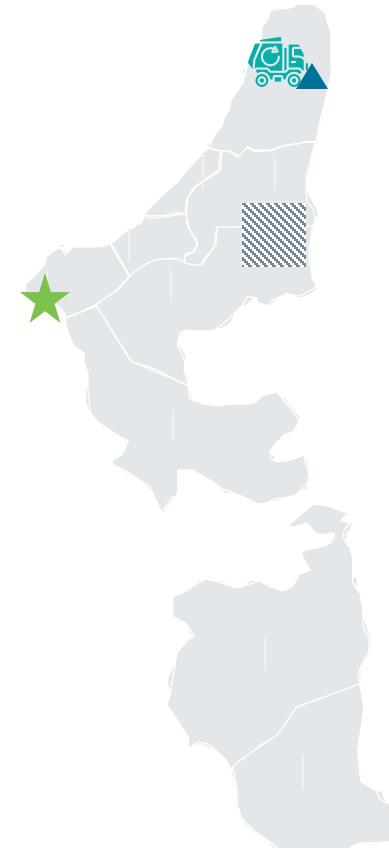
Collection fleet tracking enabler

## Overview of waste geofencing system

- Geofencing in waste tracking, widely implemented in **advanced regions** like the USA and Abu Dhabi, uses GPS technology to monitor **waste transportation in real-time**, ensuring **route compliance**
- This system helps prevent **illegal dumping** and **enhances accountability** in waste management



★ Landfill ▲ Generation site ✎ Illegal dumping site



All CDW generators' transport or contractor fleets must install **GPS sensors** to obtain a waste **generation and transportation license** from PSD



A geofencing system, utilizing **GPS sensors** combined with **optical satellite imaging**, is used to detect illegal dumping



When a fleet enters a restricted zone, an **illegal dumping alert is triggered** and notified on the **PSD monitoring platform**

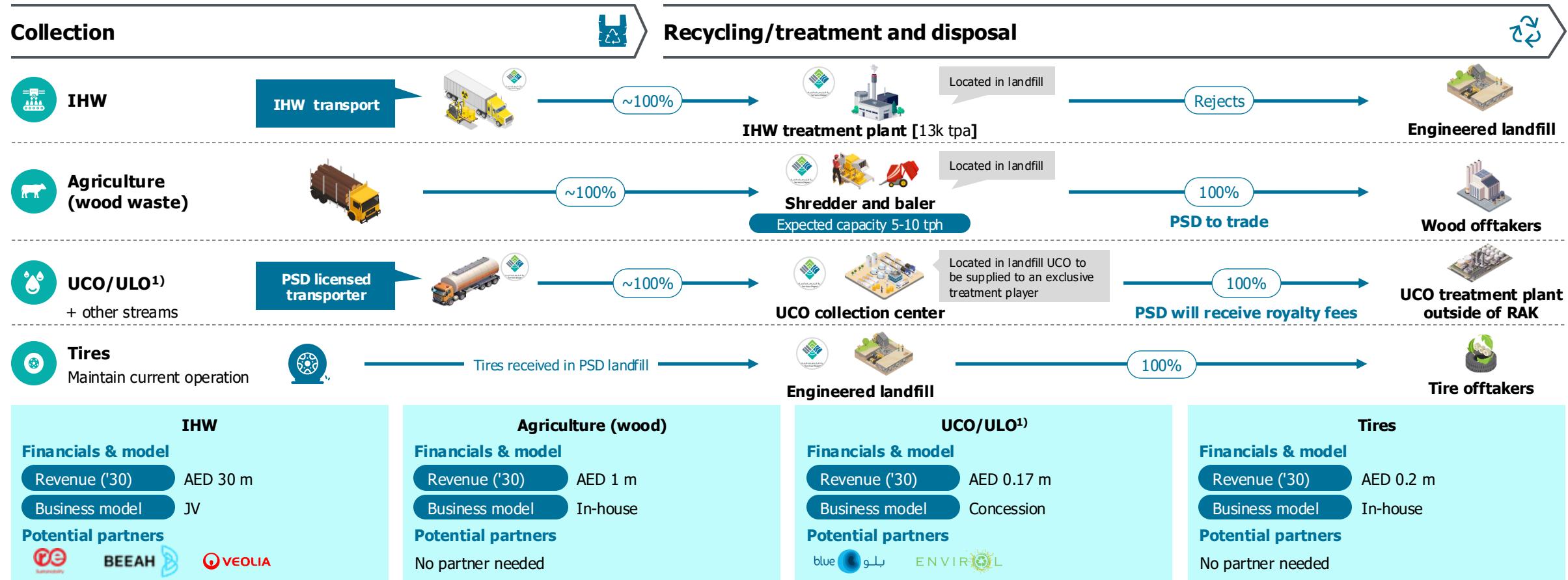


Incidents will be **reported to the responsible department or personnel**, with **fines and corrective actions** issued accordingly

**B.2.3. Participate in other waste streams to capture profitability**

# IHW will be processed at a treatment facility, wood and tires will be sold, and used cooking oil will be sent to a treatment plant

## Other waste streams overview



*Given the small quantities and infrastructure needs, PSD should adopt a waste management licensing and royalty-sharing model to formalize the sector and generate revenue*

1) Only consider UCO at current stage, ULO to be further explore as the UCO business ramp up

# For the treatment IHW, PSD could consider setting up a JV increase landfill diversion while generating attractive returns

## Opportunity card IHW treatment

Waste stream	Strategic direction	Required actions
IHW	JV / Concession	<ul style="list-style-type: none"> <li>Conduct a feasibility study to determine plant capacity, technology, and operational requirements</li> </ul>
Opportunity description	Organize & formalize	<ul style="list-style-type: none"> <li>Identify and engage private sector partners with experience in hazardous waste treatment</li> </ul>
<ul style="list-style-type: none"> <li>Set up a small IHW treatment plant to incinerate and safely treat hazardous waste</li> <li>Operate through a JV or concession to leverage private sector expertise and investment</li> </ul>	Sell feedstock	<ul style="list-style-type: none"> <li>Develop a JV/concession agreement outlining investment, roles, and revenue-sharing terms</li> </ul>
Rationale	Key information	<ul style="list-style-type: none"> <li>Design and construct the treatment plant with suitable technologies for local waste types</li> </ul>
<ul style="list-style-type: none"> <li>Volume of IHW is sufficient to justify the plant's setup and ensure operational feasibility</li> <li>Waste is currently managed at the landfill, ensuring feedstock availability and control</li> <li>IHW treatment is a common practice globally, with multiple private players available for partnerships</li> </ul>	<p>Volume: 12 k tons per annum</p> <p>Profitability: High (10-15% IRR)</p>	<ul style="list-style-type: none"> <li>Launch operations and monitor performance against environmental and financial KPIs</li> </ul>
	Potential partners	
	 	

# PSD could develop a hazardous waste treatment facility to ensure safe disposal of IHW

## Strategic options – Industrial Hazardous Waste (IHW)

IHW collection breakdown [tons, p.a.]		Strategic options
Mixed Hazardous	7,203	<b>Maintain status quo</b>
Chemical liquid Water	5,366	<ul style="list-style-type: none"> <li>Continue the <b>current practice</b> of disposing of hazardous waste in the landfill without additional treatment or processing</li> <li><b>Minimal capital and operational investment</b> but <b>risks long-term environmental, regulatory, and reputational challenges</b></li> </ul>
Clarifier Scum Waste	585	
Mixed Septic With Oil	305	
Oily Sludge	302	
Semi Solid Sludge	258	
Screening and Grit Waste	204	
Paint Waste	191	
Insulation Waste	105	
Chemical powdery Waste	100	
Other	297	
Total	14,916	<b>Develop a hazardous waste treatment facility</b> <ul style="list-style-type: none"> <li>Establish a <b>dedicated facility</b> for hazardous waste stabilization and incineration to <b>ensure safe disposal</b> and compliance with environmental regulations</li> <li>Requires <b>upfront investment</b> but mitigates environmental risks, aligns with sustainability goals, and may <b>unlock potential revenue streams</b> through partnerships or waste processing fees</li> </ul> <p><b>Recommended</b></p>

## Key takeaways

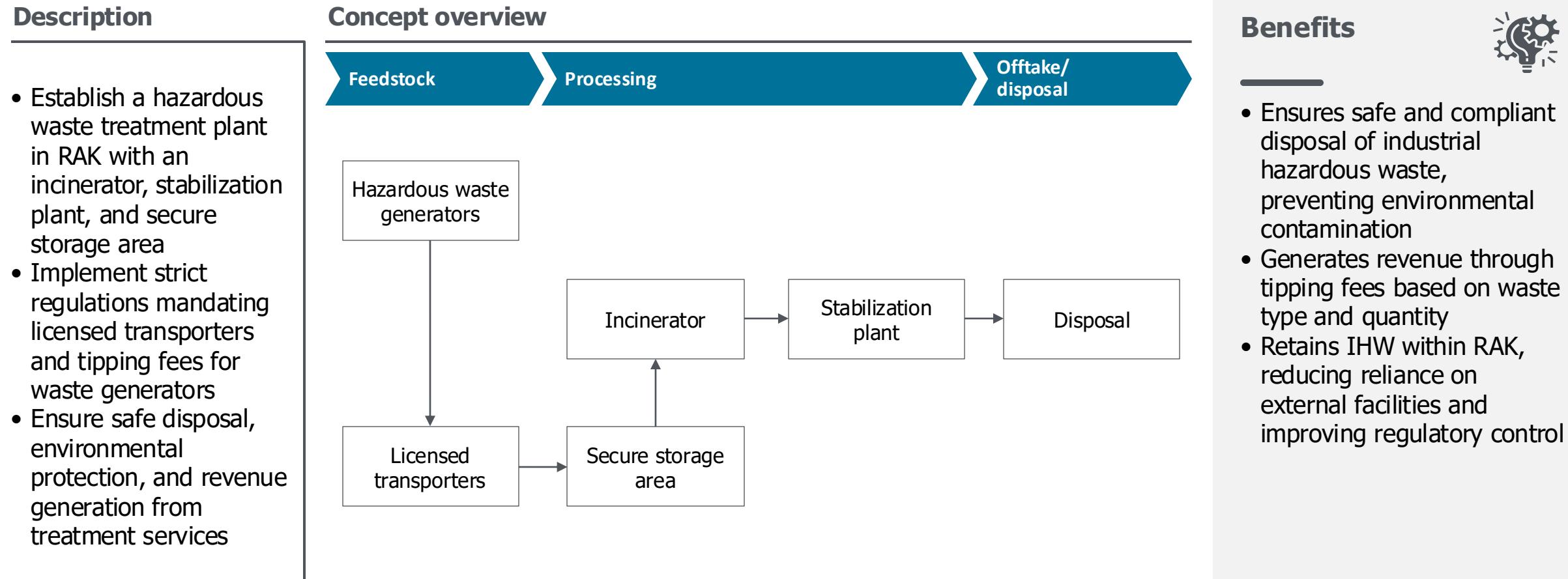


- Industrial hazardous waste (IHW) is currently charged at 400 AED per ton for landfill disposal but is **not properly treated**, leading to environmental and regulatory risks
- There is **no licensing or regulation mandating transporters to deliver IHW** to RAK's landfill, resulting in IHW potentially being transported and valorized in other emirates
- Setting up a dedicated hazardous waste treatment plant** is the ideal solution to address improper treatment, ensure regulatory compliance, and retain value within RAK's jurisdiction

1) including: Non-Recyclable Foam (84 tons p.a.), Used Oil Filter (61 tons p.a.), Alcohol (60 tons p.a.), Oil and Grease (58 tons p.a.), Medical Mixed Waste (24 tons p.a.), Oily Grit (6 tons p.a.), Electronic Waste (3 tons p.a.), Batteries (1 tons p.a)

# PSD could establish a hazardous waste treatment plant to ensure safe disposal, environmental compliance, and revenue generation

## Hazardous waste treatment plant – Concept overview



# A joint venture offers an ideal business model that balances investment, risk, and returns

IHW – Hazardous waste treatment facility partnership options

	Option 1 – Fully in-house	Option 2 – Joint Venture	Option 3 – Fully outsourced (concession model)
Schematic			
Description	PSD sets up, owns, and operates the facility independently	PSD establishes a JV with a technical partner/operator and grant the JV exclusive rights to collect and treat hazardous waste	PSD contracts a private operator to design, build, and operate the facility, with no ownership stake for PSD
Pros	<p><b>Pros</b></p> <ul style="list-style-type: none"> <li>• Full control over operations and revenue</li> <li>• Alignment with regulatory goals and standards</li> </ul>	<p><b>Pros</b></p> <ul style="list-style-type: none"> <li>• Leverages technical expertise of the partner</li> <li>• Reduces CAPEX burden for PSD</li> <li>• Maximizes revenue potential through tipping fees and profit-sharing in the JV</li> </ul>	<p><b>Pros</b></p> <ul style="list-style-type: none"> <li>• No CAPEX required for PSD</li> <li>• Transfers operational and technical risks to the private operator</li> <li>• Simplifies project implementation for PSD</li> </ul>
Cons	<p><b>Cons</b></p> <ul style="list-style-type: none"> <li>• Lack of technical expertise to design, build, and operate the facility</li> <li>• High CAPEX and OPEX</li> <li>• Significant operational risks and potential inefficiencies resulting in longer timelines</li> </ul>	<p><b>Cons</b></p> <ul style="list-style-type: none"> <li>• Shared control with the partner may limit decision-making autonomy</li> <li>• Requires strong regulatory enforcement to maintain exclusivity and ensure compliance</li> </ul>	<p><b>Cons</b></p> <ul style="list-style-type: none"> <li>• Limited revenue generation, as the private operator retains most profits</li> <li>• Reduced influence over operational decisions and regulatory alignment</li> <li>• Reliance on private sector efficiency and compliance</li> </ul>

# PSD could maximize waste value and generate additional by selling shredded and baled wood waste

Strategic options - Agriculture and animal waste

	Waste type	Strategic options	Rationale
Agriculture waste	Green waste	<p><b>Wood shredding &amp; sales</b> Shredding of wood waste and sell to offtakers</p> <p><b>Advanced treatment</b> Converting wood waste into woodboards, paper, pulp etc.</p>	 <ul style="list-style-type: none"> <li>Wood shredding allows the wood waste to be sold to offtakers which could use the feedstock as a renewable energy source</li> <li>Advanced treatment requires more specialized equipment and large volumes to reach profitability</li> </ul>
	Wood waste	<p><b>Composting</b> Converts green waste into nutrient-rich compost for agricultural or landscaping use</p>	
Animal waste	24		
	12		
Animal waste	Camel waste	<p><b>Feedstock sales</b> Sold as feedstock for cement plants, as it can be used as an alternative fuel source</p> <p><b>Composting</b> Turns camel manure into organic compost for use as a natural fertilizer</p>	<ul style="list-style-type: none"> <li>Cement plants have high demand for camel waste as an alternative fuel source</li> <li>Anaerobic digestion facility set-up is costly, while feedstock is limited, and compost has limited local demand</li> </ul>
	21	<p><b>Recommended</b></p> <p><b>Anaerobic digestion</b> Processes manure into biogas for energy and digestate for fertilizer</p>	

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Total annual waste collected by PSD (k tons, p.a.)

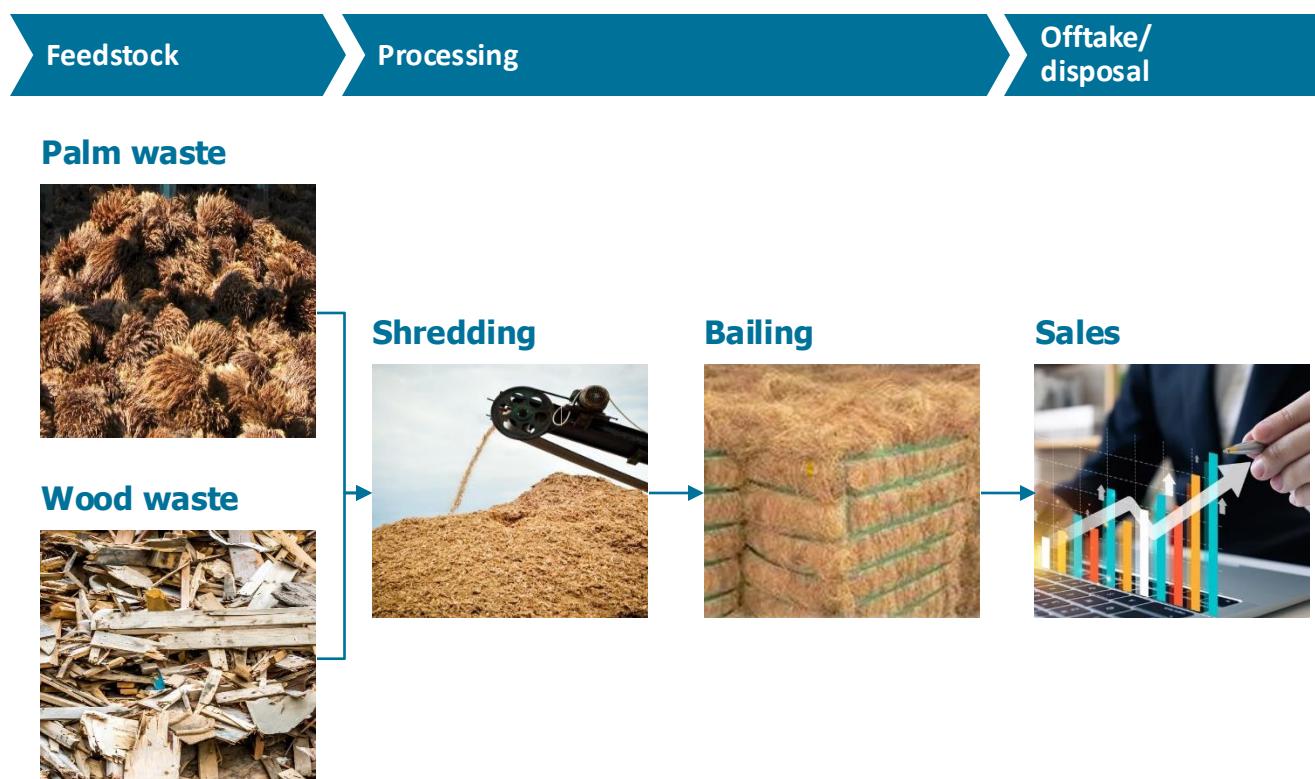
# PSD could shred the wood waste to sell it to offtakers which can use the refined waste as an alternative fuel source

## Agriculture waste – Wood shredding & sales

### Description

- A biomass processing facility converts agricultural waste (palm and wood waste) into **prepared biomass feedstock**
- The waste is shredded, dried, and refined to **meet specifications** required by offtakers
- The processed material could be used as clean, high-calorific fuel

### Concept overview



### Benefits



- Supplies offtakers with consistent, high-calorific feedstock for efficient energy production
- Reduces reliance on landfills, lowering environmental impact
- Monetizes agricultural waste by transforming it into a valuable energy resource
- Promotes circular economy by converting waste into renewable energy feedstock

# Setting up an in-house shredding operation is advisable due to simple processes and the ability to capture the full revenue potential

Agriculture waste – Wood shredding & sales partnership options

Option 1 – Sell feedstock		Option 2 – Set-up own shredding operations	Option 3 – Establish a JV with a partner
Schematic	Description	Selected option	
 <pre> graph LR     A[Feedstock] -- "Sold" --&gt; B[Offtaker]   </pre>	PSD collects agricultural waste and sells it as raw feedstock to an existing or third-party wood shredding facility, with no additional processing	 <pre> graph LR     A[Feedstock] --&gt; B[Treatment in facility]     B --&gt; C[Offtaker]   </pre>	 <pre> graph LR     A[Feedstock] --&gt; B[Treatment in facility]     B --&gt; C[Offtaker]   </pre>
<b>Pros</b> <ul style="list-style-type: none"> <li>Minimal capital investment and operational effort</li> <li>Quick and easy to implement</li> </ul>	<b>Pros</b> <ul style="list-style-type: none"> <li>Captures full revenue potential across the value chain</li> <li>Ensures complete control over operations &amp; quality</li> </ul>	<b>Pros</b> <ul style="list-style-type: none"> <li>Shares financial and operational risks with a partner</li> <li>Leverages partner's technical expertise for efficient operations</li> </ul>	
<b>Cons</b> <ul style="list-style-type: none"> <li>Generates lower revenue compared to processed feedstock</li> </ul>	<b>Cons</b> <ul style="list-style-type: none"> <li>Higher capital costs</li> </ul>	<b>Cons</b> <ul style="list-style-type: none"> <li>Revenue is shared with the partner</li> <li>Requires structured agreements to ensure alignment</li> </ul>	

# For the treatment of UCO/ULO, PSD could consider organizing and formalizing the sector by regulation and establishing partnerships with private operators

## Opportunity card UCO/ULO treatment

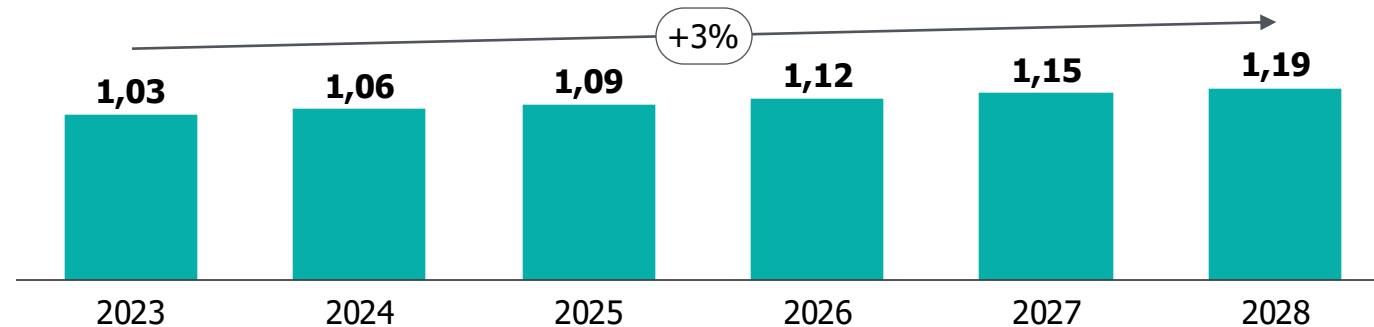
Waste stream	Strategic direction	Required actions
UCO/ULO <sup>1)</sup>	JV / Concession      Organize & formalize      Sell feedstock	<ul style="list-style-type: none"> <li>Issue an RFP and concession to grant exclusive rights for UCO and ULO treatment</li> <li>Define a royalty structure tied to waste volumes and operator revenue</li> <li>Enact policies mandating waste generators to hand over UCO and ULO exclusively to certified (NoC-approved) collection companies</li> <li>Require collection companies to ensure the proper transportation of collected UCO to designated collection centers within the new landfill site</li> <li>Establish systems to track volumes, enforce regulations, and ensure operator compliance</li> <li>Conduct outreach to educate waste generators on new policies and benefits</li> </ul>
Opportunity description	Key information <sup>1)</sup>	
<ul style="list-style-type: none"> <li>Formalize and regulate the UCO/ULO waste stream by mandating collection at designated points and developing partnerships with private operators</li> </ul>	<p><b>Volume</b> 1-1.2 k tons per annum</p> <p><b>Revenue potential</b> AED 0.1 – 0.2 m</p>	
Rationale	Potential partners	
<ul style="list-style-type: none"> <li>UCO/ULO is a valuable waste stream that can be converted into high-demand products, creating revenue opportunities</li> <li>PSD does not currently possess control over the feedstock, leading to inefficiencies in collection and utilization</li> <li>Formalizing the UCO/ULO stream through regulations and enforcement ensures consistent supply and prevents illegal disposal practices</li> </ul>	 	

<sup>1)</sup> Focusing on UCO at the current stage and apply the same business model to ULO in the future

# Both UCO and ULO are expected to grow, driven by tourism development and population growth, while PSD currently lacks control over these waste streams

Overview of UCO and ULO in RAK

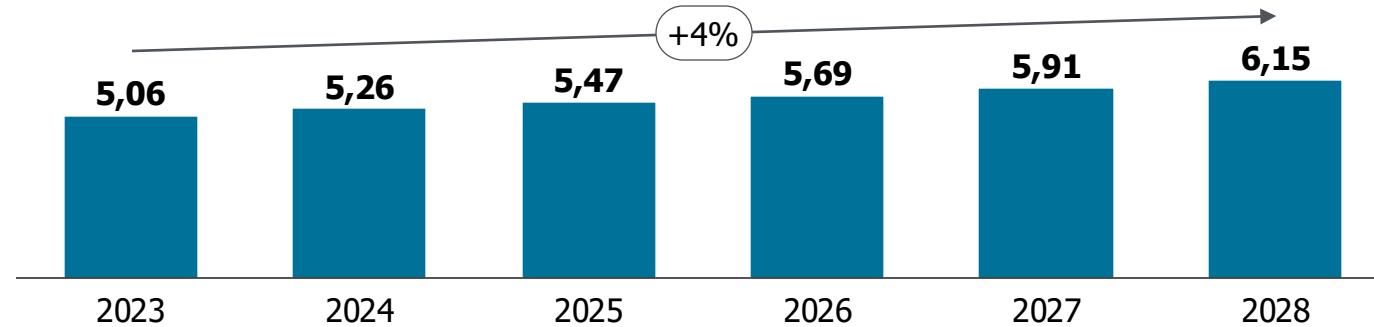
## RAK UCO market size by volume [k tons]



## Current collection rate

0%

## RAK ULO market size by volume [k tons]



## Key insights



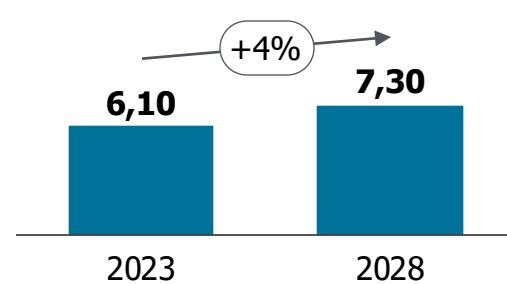
- UCO generation is expected to grow at a CAGR of 3% as the RAK population expand, reaching 1.2 k tons annually
- ULO generation will increase with economic development, driven by population growth and rising car numbers, reaching 6k tons per year by 2028
- Both oil-based waste streams are highly profitable, but currently, none are collected by PSD
- UCO/ULO market is too small to set up a dedicated treatment facility within RAK

# To formalize UCO/ULO waste streams, PSD can grant exclusivity to a single waste operator for handling all UCO/ULO in RAK

Overview of UCO/ULO strategic options

## Current challenges

Total UCO/ULO volume [k tons p.a.]

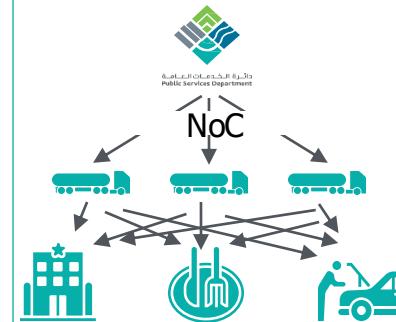


- **Fragmented** market with **unorganized** collection practices
- Lack of **control** over waste flow and **visibility** on waste volumes
- Waste **value leaked** outside of RAK

■ Recommended option    Deep dive on next slide

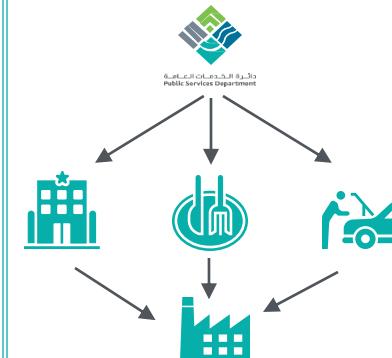
## Strategic options

### Option 1 – Maintain status quo



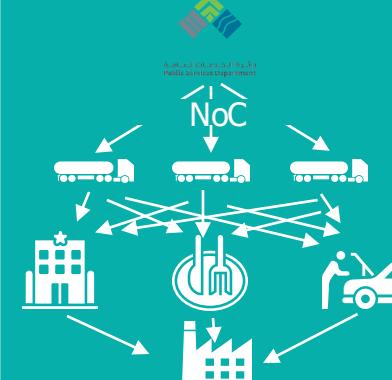
- Maintain the current approach, PSD to issue NoCs granting waste operators the right to collect and transport UCO/ULO from generators

### Option 2 – Set-up own treatment plant



- PSD builds and operates its own UCO/ULO treatment facility, managing the entire value chain from collection to feedstock processing

### Option 3 – Grant exclusive treatment rights



- PSD grants exclusive treatment right to single waste operator to receive all UCO and ULO in RAK and generate revenue from royalties

## Strategic consideration

Option 3 is the recommended option at current stage due to:

- NoCs do **not generate substantial revenue** and add **complexity** in **overseeing and controlling** waste flow and the sector
- **Limited waste volume** makes facility setup **economically unfeasible**

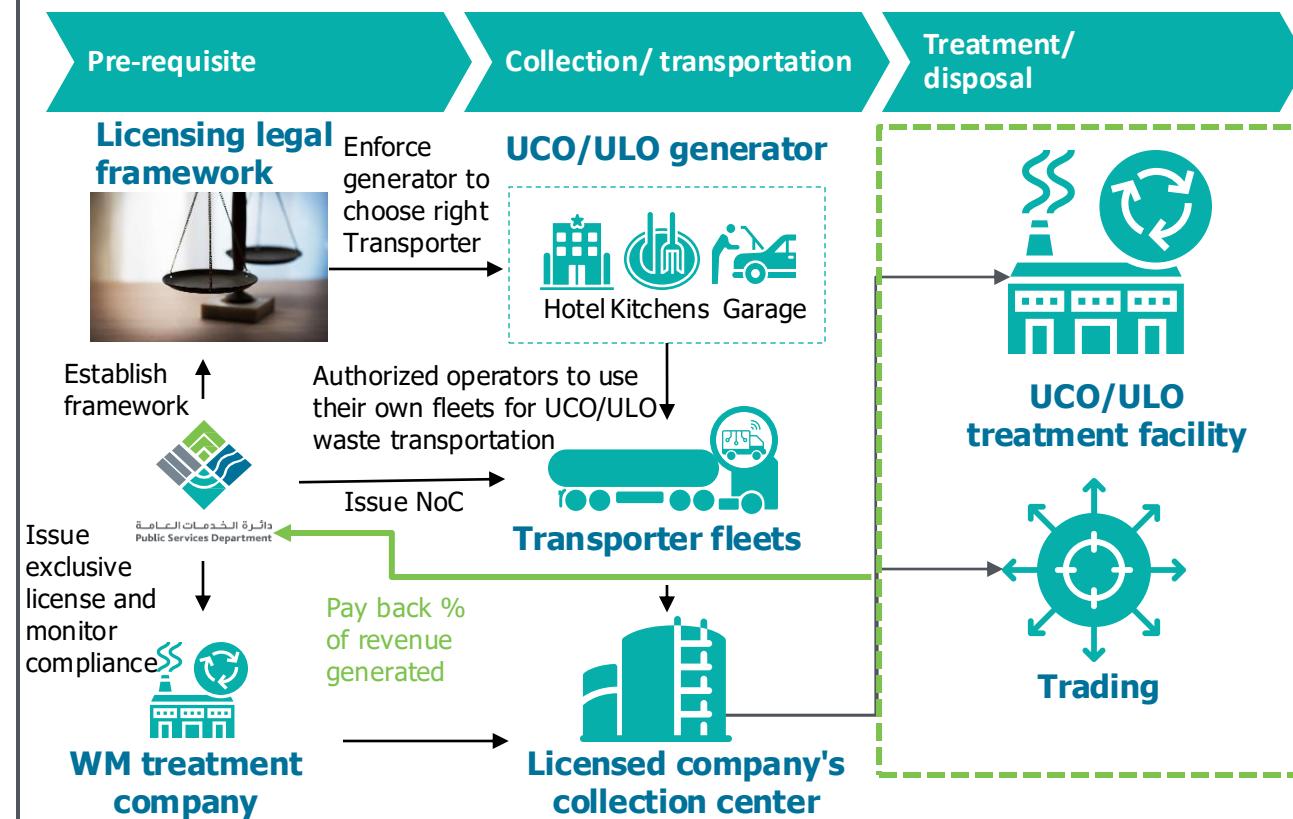
# Granting exclusive treatment rights allows PSD to formalize UCO/ULO waste streams in RAK while generating consistent revenue without additional CAPEX

Strategic option 3 - Grant exclusive treatment rights

## Description

- Develop a regulatory licensing framework requiring all waste operators to obtain a license or NoCs to handle waste in RAK
- Establish a legal framework mandating that only PSD or licensed operators can treat and receive waste
- Issue an exclusive license to a single operator for the receiving of UCO/ULO in RAK and enforce transporters to dispose waste in licensed facility
- Implement a revenue sharing mechanism, charging a percentage of revenue generated

## Concept overview



## Benefits



### Environmental improvement

- Ensure formalized hazardous material disposal and handling practices

### Revenue generation

- Provide PSD with a consistent income stream without requiring additional CAPEX

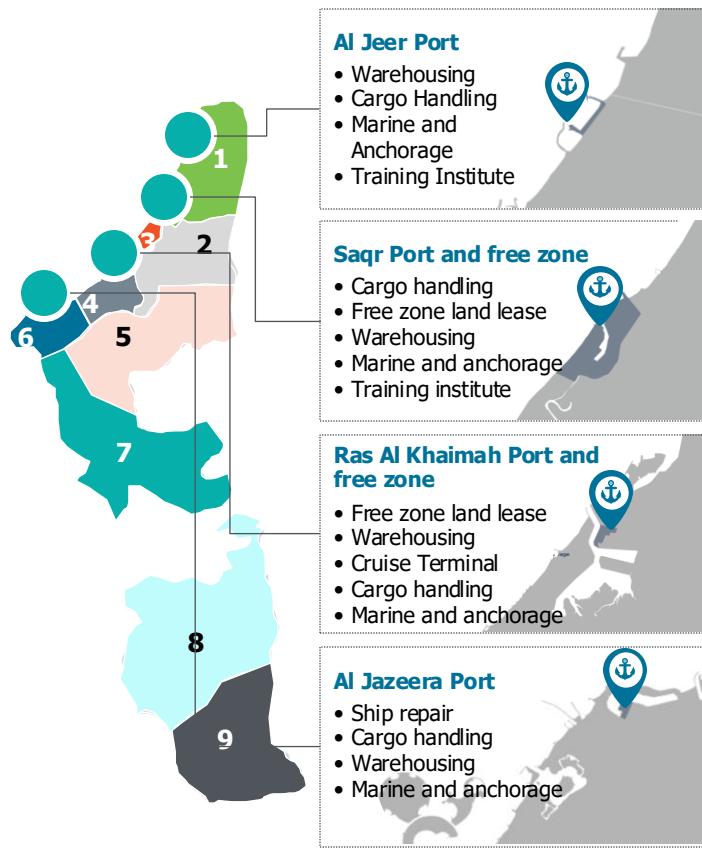
### Operational efficiency

- Leverage licensed WM company to support the inspection and monitoring

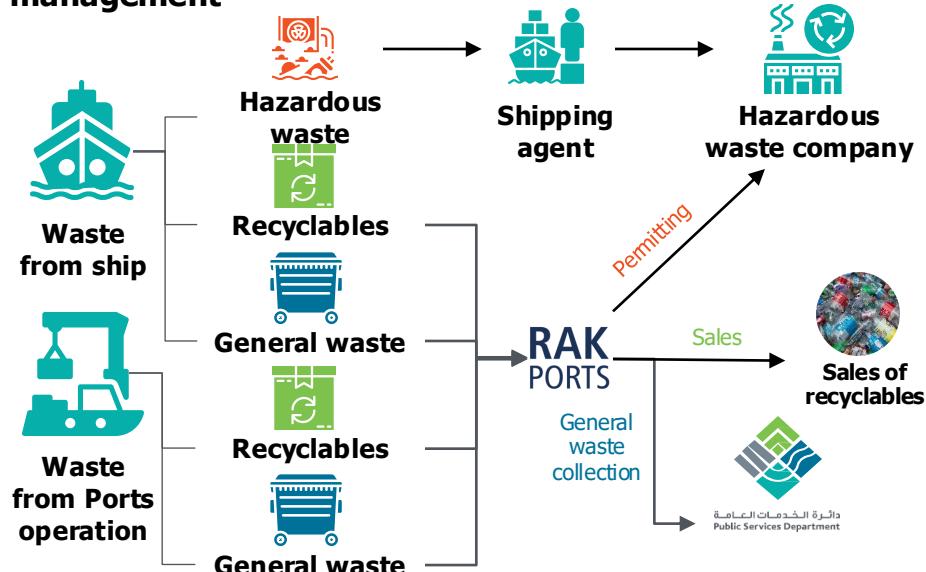
# Given the lack of jurisdiction over RAK Ports, PSD's involvement is limited to collaborating with RAK Ports on the development of marine waste guidelines

Overview of marine waste strategic option

## Overview of RAK Ports



- RAK Ports, a government-owned entity, **manages and operates all four ports** and port free zones in Ras Al Khaimah
- RAK Ports holds **full authority and ownership** over all operations within the free zones, **including waste management**



**PSD does not have jurisdiction over RAK Port freezones**

## PSD involvement



### Challenge

- Suboptimal waste sorting at the source by ships leads to increased disposal costs charged by PSD

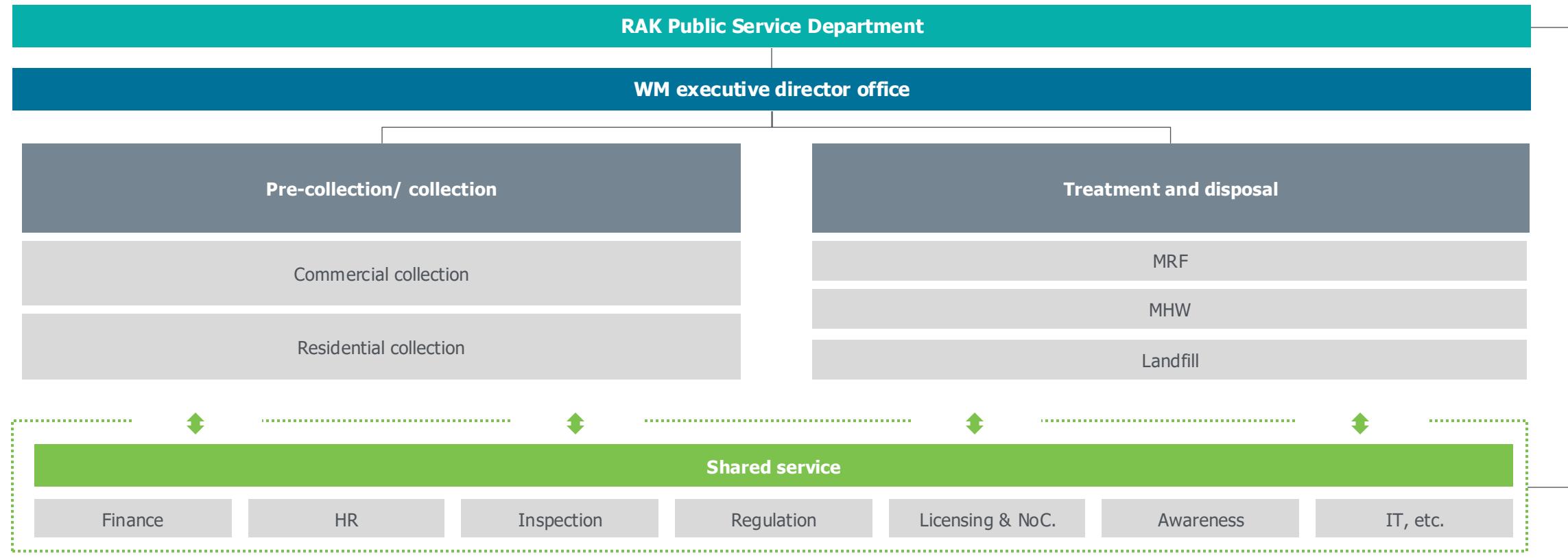
### PSD contribution

- Partner with RAK Ports to develop marine waste guidelines that ensure proper sorting of hazardous and non-hazardous waste at the source, both on ships and at the port

## B.2.4. Strategy enablers

# WMA can be structured by the waste value chain and streams, with each sub-department/BU maintaining its own WM and financial reports for accountability

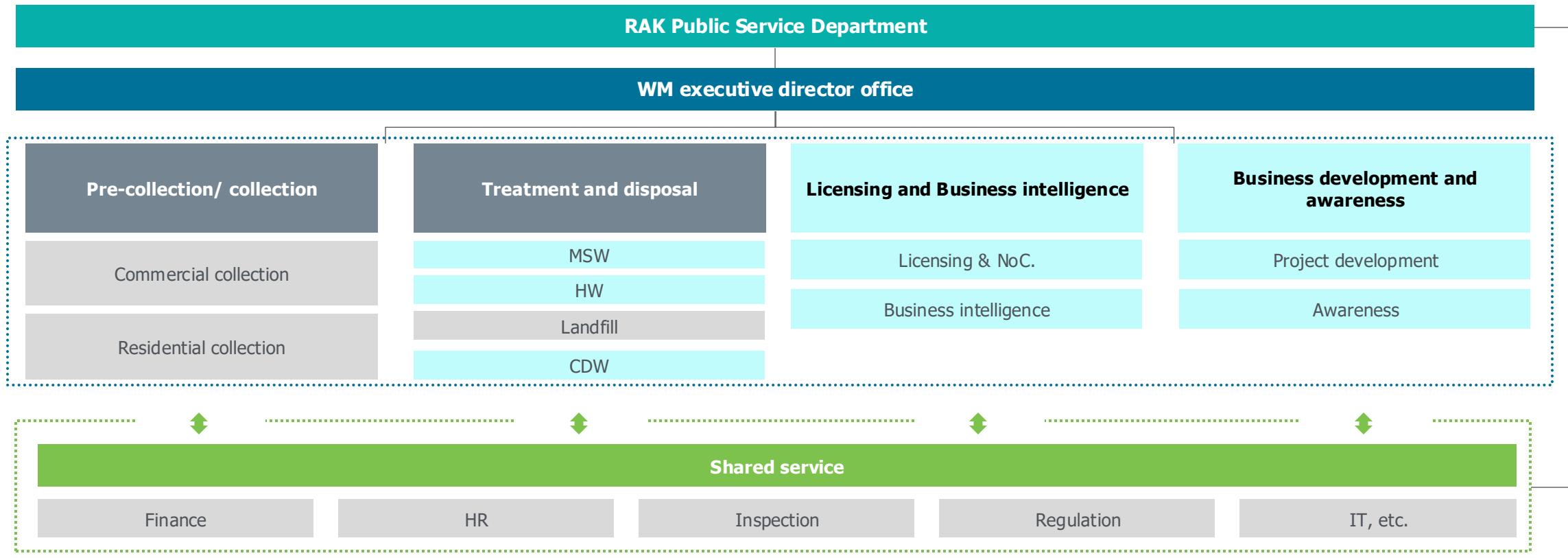
Overview of Waste Management Agency organizational structure – [Current state]



Shared service at PSD level

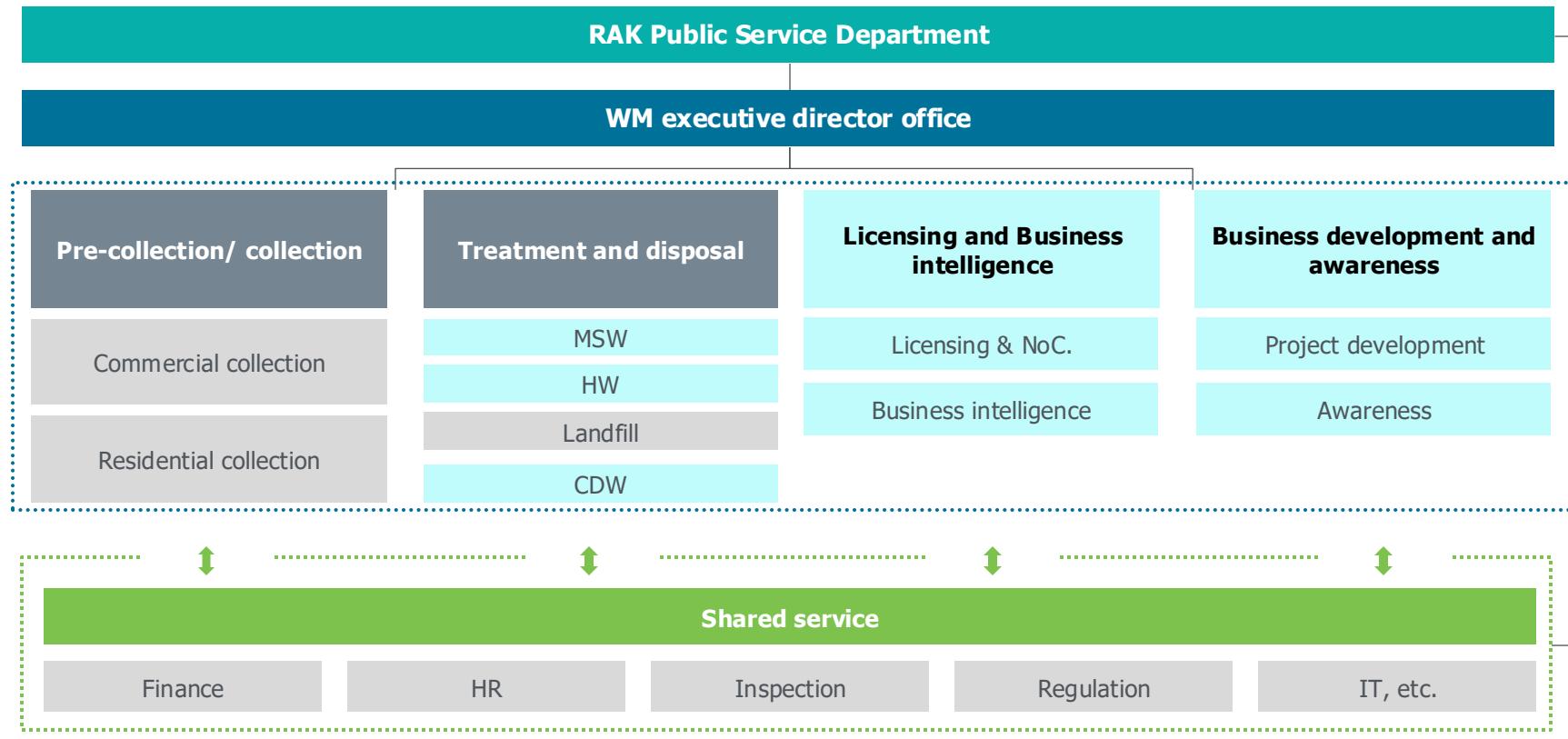
# The revised structure introduces two new business units and strengthen the existing treatment unit

Overview of Waste Management Agency organizational structure – [Proposed state]



# The revised structure introduces two new business units and strengthen the existing treatment unit

Overview of Waste Management Agency organizational structure – [Proposed state]

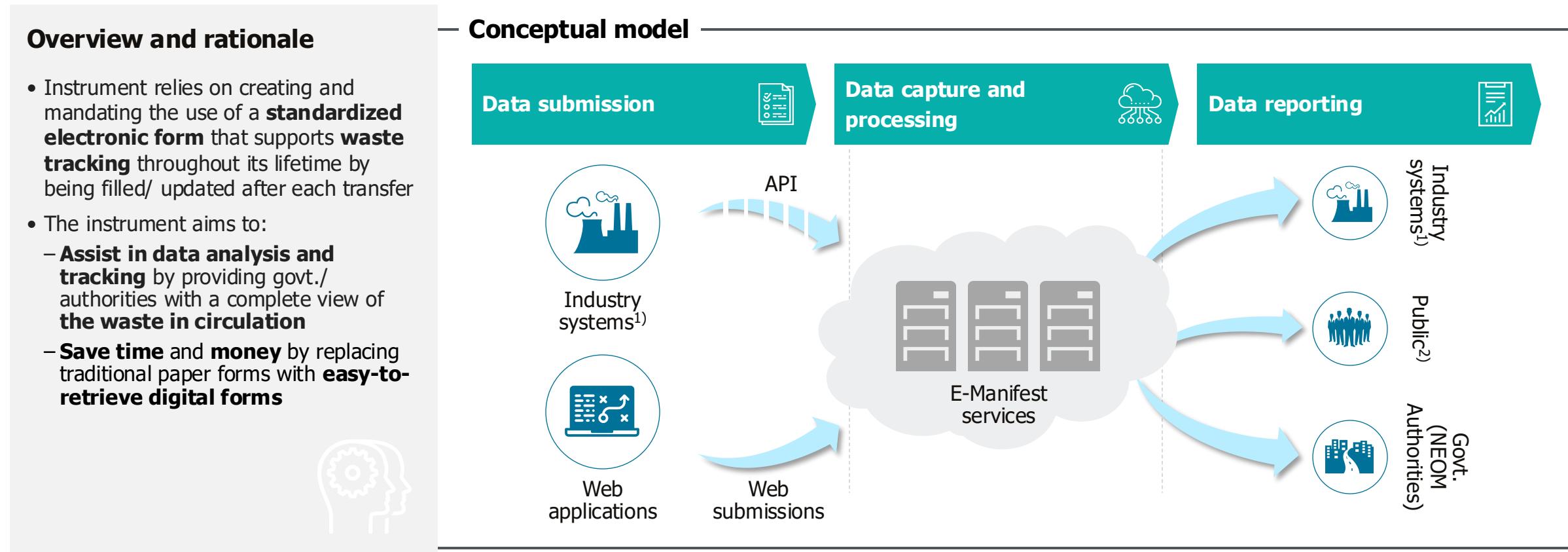


## Key benefit

-  Clear accountability
-  High specialization
-  Improved financial transparency
-  Cost synergies from shared services

# The E-Manifest provides a digital solution to track waste movements across the value chain efficiently fostering regulatory compliance

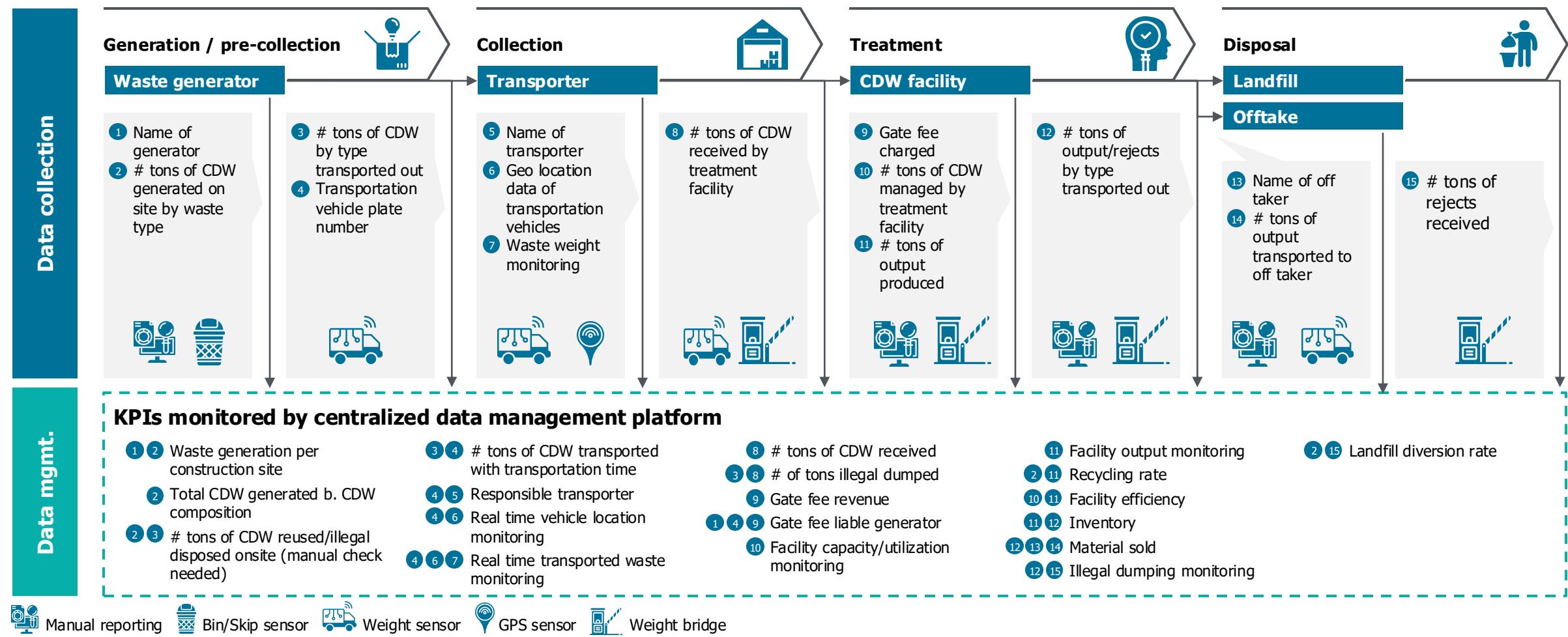
## E-manifest – Key concepts



1) Various software and technological solutions used by companies involved in waste management which must be integrated with the E-manifest system; 2) Information usually available with a delay (e.g., 90 days)

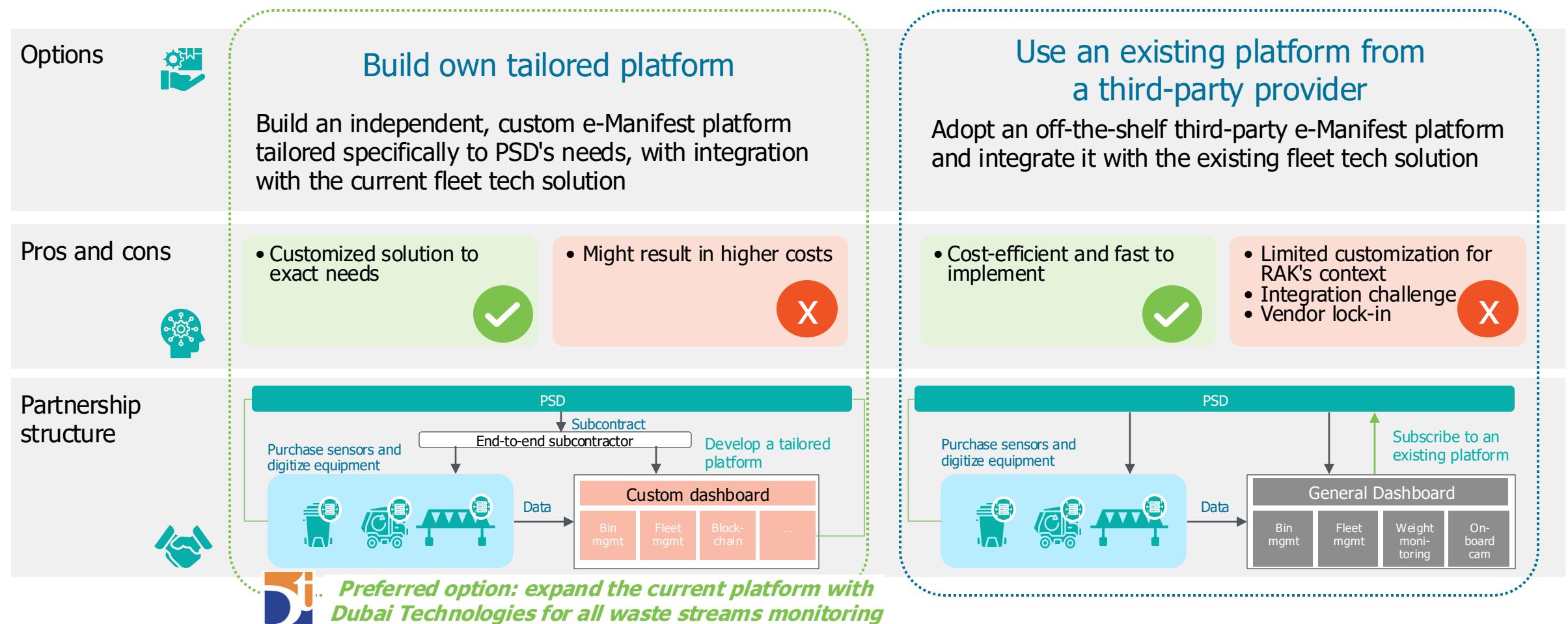
# E-manifest system combines manual reporting and sensors to collect comprehensive waste data, enabling PSD to better understand the sector

## E-manifest data collection and management [CDW]



# PSD can build on its ongoing project with Dubai Digital to enhance platform features for monitoring of all waste streams across the value chain

E-manifest and centralized data management implementation



# We identified two primary objectives for awareness efforts and four key target audiences to educate and engage

## Awareness overview

— Awareness objective —  
— Audience —



### Waste reduction

To educate the public on environmental, economic, and social impacts of waste (particularly focusing on food waste) and promote behavioral change to minimize waste at the source to reduce waste management demand



### Sorting at source

Educate on the importance of waste segregation and promote behavioral change to ensure proper separation at the source, enhancing recycling efficiency and maximizing revenue for proposed facilities



#### Residential



#### Tourism destination



#### Educational institution



#### Construction

# Awareness programs for residents should focus on daily behavior change, ensuring broad reach and effective incentives

## Awareness program – Residential



Audience and sub audience	Preferred channels	Tools and incentives	Key messages	KPIs and monitoring mechanism
<b>Residential</b> <ul style="list-style-type: none"> <li>Residential area</li> <li>Community</li> <li>General public</li> </ul>	<b>Social media /TV broadcast/ Street ads</b> Maximize awareness campaign reach and create reinforcement effect on key messages			<b>% of target audience reached</b> Social media data with manual recording
	<b>Direct engagement</b> Face to face message passing to raise sense of importance and ensure compliance		<b>Waste reduction (collaboration with Ne'ma)</b> <ul style="list-style-type: none"> <li>Encourage the audience to adopt sustainable purchasing habits by buying only what they need and minimizing single-use products</li> <li>Introduce practical ways to reduce waste during product use, such as tracking expiration dates and donating surplus food</li> </ul>	<b># tons decrease in the food waste generated per household</b> Waste auditing and survey
	<b>Short video</b> Capture attention and convey messages quickly in a clear and easily understandable manner		<b>Sorting at source</b> <ul style="list-style-type: none"> <li>Inform the audience about the new bin sorting system</li> <li>Explain the types of waste designated for each color-coded bin</li> <li>Educate on the impact of sorting and the importance of individual contributions</li> </ul>	<b># tons of food waste donated</b> Manual recording
	<b>Infographic</b> Informational material designed to last and be reviewed as needed			<b>Waste reduction awareness</b> Survey
	<b>PoS discount</b> Collaborate with retailers to provide discounts as rewards for compliance			<b># of recyclables collected from residents</b> Weight sensor and weight bridge data
	<b>Educational workshop</b> Interactive sessions help participants learn practical actions			

# Awareness programs for tourism destination should focus on employee training workshops and marketing incentives for hotel participation

## Awareness program – Tourism destination



Audience and sub audience		Preferred channels		Tools and incentives		Key messages		KPIs and monitoring mechanism	
<h2>Tourism destination</h2> <ul style="list-style-type: none"> <li>• Hotel employee</li> <li>• Tourists</li> </ul>		<p><b>RAKTDA website</b></p> <p>Leverage RAKTDA to create marketing effect to attract hotels to participate</p>	<p><b>Direct engagement</b></p> <p>Face to face message passing to raise sense of importance and ensure compliance</p>	<p><b>Interactive activities</b></p> <p>Fun and meaningful activities that attracts tourist to participate</p>	<p><b>Infographic</b></p> <p>Informational material designed to last and be reviewed as needed</p>	<p><b>Educational workshop</b></p> <p>Interactive sessions help participants learn practical actions</p>	<p><b>Green hotel award</b></p> <p>Introduce green hotel award for hotel to leverage as a marketing and branding material</p>	<p><b># of initiative launched</b></p> <p>Manual recording</p>	
<h2>Main objective</h2> <ul style="list-style-type: none"> <li>• Educate hotel employees about the newly implemented sorting system to ensure proper compliance</li> <li>• Communicate sustainability messages to tourists to develop a sustainable brand image</li> </ul>						<p><b>Waste reduction (collaboration with Ne'ma)</b></p> <ul style="list-style-type: none"> <li>• Provide guidance to hotel kitchens on effective menu planning and portion control to minimize food waste</li> <li>• Utilize the Green Hotel Award and RAKTDA website announcements to encourage hotels to ban single-use products and implement innovative waste reduction initiatives</li> <li>• Highlight the impact of food waste and RAK's commitment to reducing it, raising awareness among tourists</li> </ul> <p><b>Sorting at source</b></p> <ul style="list-style-type: none"> <li>• Educate hotel employees on waste sorting practices and the newly implemented three-bin system</li> <li>• Train employees on separating organic waste and utilizing digesters or composters for on-site treatment</li> <li>• Assist hotels in developing customized waste sorting processes tailored to their operations</li> <li>• Raise awareness among tourists about the importance of waste sorting and the impact of plastic waste on tourism destinations</li> </ul>	<p><b># tons of organic waste treated onsite</b></p> <p>Hotel reporting</p>		
<h2>Main external stakeholders</h2> <ul style="list-style-type: none"> <li>• Ne'ma</li> <li>• RAKTDA<sup>1)</sup></li> </ul>							<p><b>% reduction in food waste from hotels</b></p> <p>Hotel reporting</p>		
							<p><b>Green Hotel Awareness criteria</b></p> <p>Survey</p>		
							<p><b># of recyclables collected from hotels</b></p> <p>Weight sensor and weight bridge data</p>		

1) Ras Al Khaimah Tourism Development Authority

# PSD can collaborate with DoK to develop awareness programs for schools and implement a mandatory curriculum to cultivate a sustainable culture

## Awareness program – Educational institution



Audience and sub audience	Preferred channels	Tools and incentives	Key messages	KPIs and monitoring mechanism
<b>Educational institution</b> <ul style="list-style-type: none"> <li>Students</li> <li>Teachers</li> <li>Parents</li> </ul> <b>Main objective</b> <ul style="list-style-type: none"> <li>Instills knowledge about environmental challenges and sustainable practices from a young age, shaping lifelong habits</li> </ul> <b>Main external stakeholders</b> <ul style="list-style-type: none"> <li>RAK Department of Knowledge</li> </ul>	<b>Educational website</b> <p>Leverage online websites with curriculum to educate students from home</p> <b>Direct engagement</b> <p>Collaborate with school and teacher to deliver the knowledge face to face</p> <b>Educational curriculum</b> <p>Mandatory curriculum (online/offline) to ensure the participation of students</p> <b>Educational workshop</b> <p>Interactive sessions with engaging and entertaining elements make WM learning memorable and motivating for students</p> <b>Sustainability award</b> <p>Offering small prizes and certificates for achievement to add an element of motivation and fun</p>		<p><b>Key messages</b></p> <p><b>Waste reduction (collaboration with Ne'ma)</b></p> <ul style="list-style-type: none"> <li>Introduce the concept of food waste and highlight the impact of food waste (socially and economically)</li> <li>Educate eating and consumption habit (take exactly what you need) that support the food waste reduction</li> <li>Inform and show examples of ways of reusing waste (e.g., plastic bottles)</li> </ul> <p><b>Sorting at source</b></p> <ul style="list-style-type: none"> <li>Educate the impact of plastic/paper and other waste from environmental perspective</li> <li>Explain the types of waste and the systems used for sorting (implement 2-3 bin system at school for students to participate)</li> </ul>	<b># of workshop /curriculum delivered</b> <p>School reporting</p> <b>% participation rate of schools</b> <p>Survey</p> <b># tons of food waste collected from school</b> <p>Weight sensor and weight bridge data</p> <b>Student and parent awareness &amp; behavior change</b> <p>Survey</p> <b># of recyclables collected from school</b> <p>Weight sensor and weight bridge data</p>

# Awareness program for construction will focus on CDW sorting, emphasizing that mixed CDW increases costs

## Awareness program – Construction

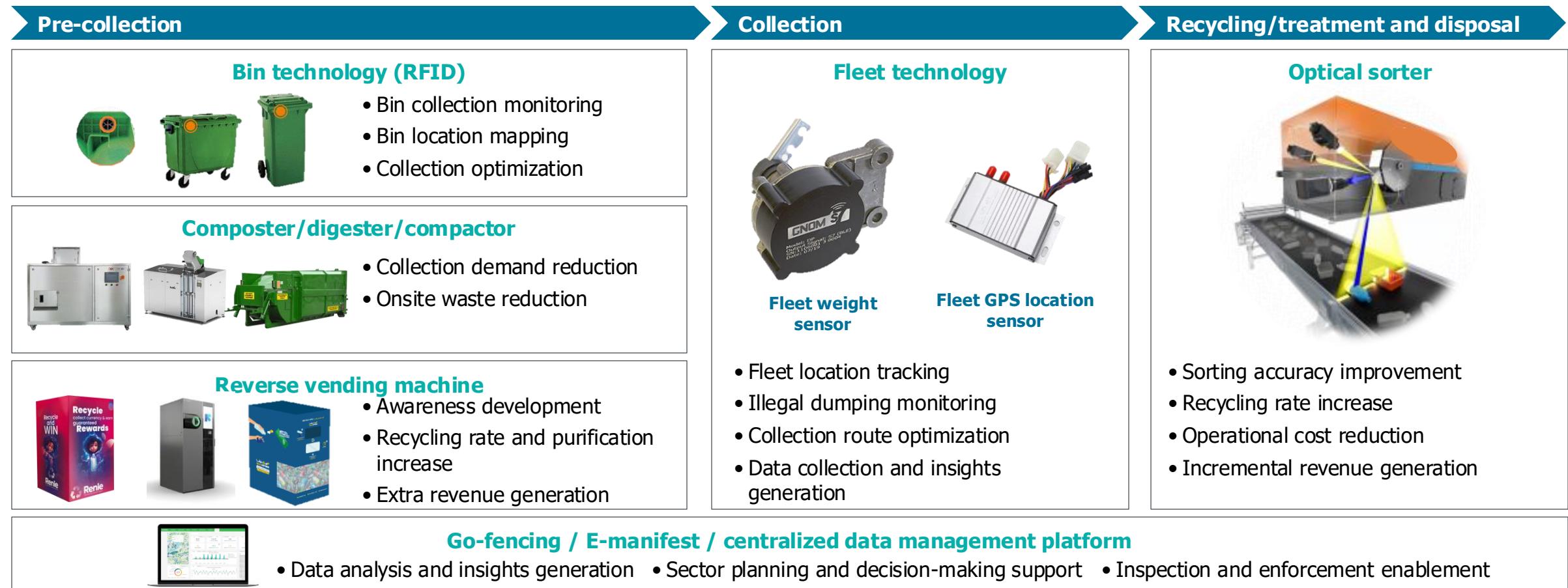


Audience and sub audience	Preferred channels	Key messages	KPIs and monitoring mechanism
<b>Construction</b> <ul style="list-style-type: none"> <li>• EPC/construction sites</li> <li>• Developer</li> </ul>	<b>PSD website</b> Sorting knowledge posted on official website for EPC and developer to follow	<b>Sorting at source</b> <ul style="list-style-type: none"> <li>• Educate the CDW waste types and sorting skips required for CDW</li> <li>• Introduce the implemented policies and fines/fees for clean and mixed CDW to emphasize their importance and highlight how sorting at the source can reduce costs</li> </ul>	<b>% of clean CDW collected</b> Weight sensor and weight bridge data
<b>Main objective</b> <ul style="list-style-type: none"> <li>• Delivery message on mandatory compliance of sorting at source at construction site</li> </ul>	<b>Direct engagement</b> Face to face message passing to ensure sorting compliance		<b># of site visit conducted</b> Manual recording
<b>Main external stakeholders</b> <ul style="list-style-type: none"> <li>• RAK Municipality</li> </ul>	<b>Infographic</b> Informational material designed to last and be reviewed by workers / employees as needed		
	<b>Educational workshop</b> Informational sessions with sorting knowledge help participants learn practical actions		
	<b>Mystery site visit</b> Conducted unscheduled site visits to check and inspect the compliance		<b>Worker and developer awareness &amp; behavior change</b> Survey



# We have planned the implementation of innovative technologies across the waste value chain to support and enable the RAK WM strategy

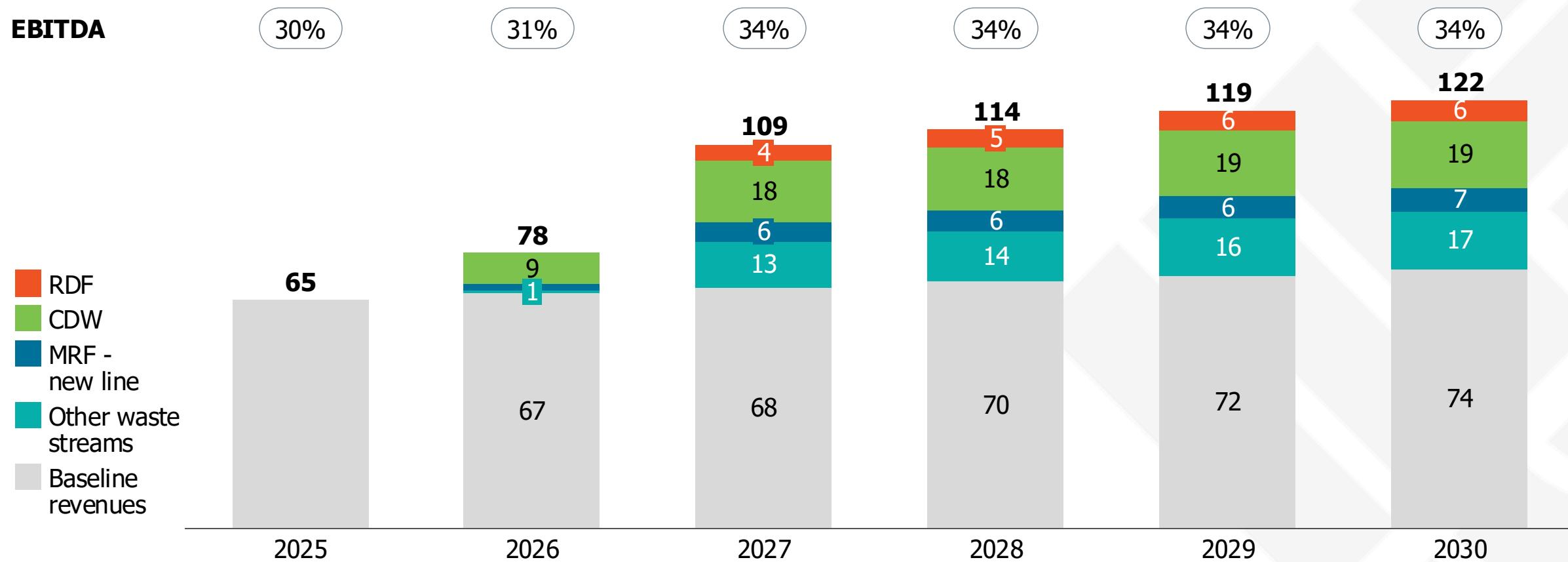
## Overview of applied innovation



## B.3. Financials

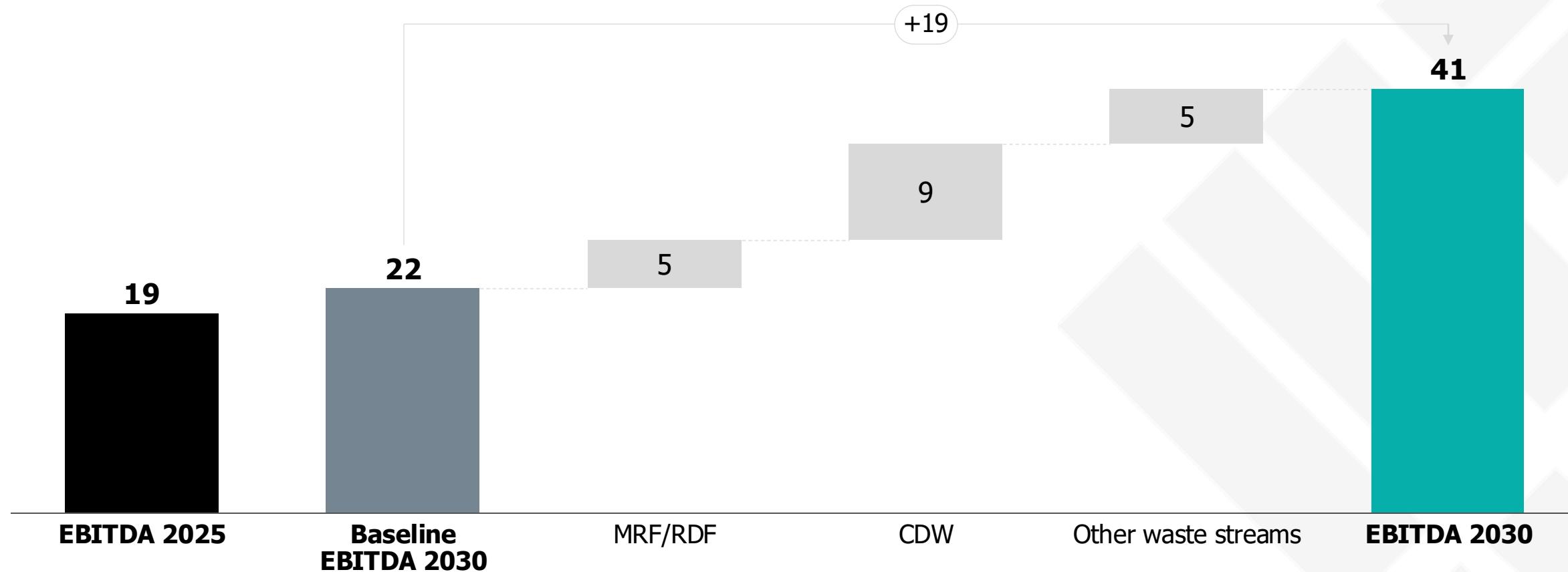
**With the implementation of new strategy, PSD will be able to reach revenues of ~AED 120 m with the EBITDA margin of 34% in 2030**

Revenue evolution – PSD WM department



**Compared to the 2030 baseline, EBITDA is expected to increase by AED ~20 m reaching ~AED 40 m**

EBITDA evolution – PSD WM department



# The strategy will require a cumulative investment of ~AED 286 m to be deployed over the next years

Overview of investment required

		Project investment	PSD required investment	CAPEX injection year		
	<b>Refuse-derived fuel (RDF)</b>		AED 20 m	AED 10 m <sup>1)</sup>	2025	Investment in facility civils works, RDF required equipment purchase and vehicles
	<b>Construction and Demolition Waste (CDW)</b>		AED 33 m	AED 33 m	2025	Investment in CDW fixed facility civils works, required equipment purchase and vehicles
	<b>Materials Recovery Facility (MRF)</b>		AED 64 m	AED 32 m <sup>1)</sup>	2025	Investment in civils works, MRF equipment, and vehicles
	<b>Landfill</b>		AED 38 m (capping) AED 55 m (new landfill)	AED 38 m (capping) AED 55 m (new landfill)	2025	Investment in civils works of current landfill capping and new landfill development
	<b>Other waste streams (Wood and IHW)</b>		AED 46 m	AED 23 m <sup>1)</sup>	2026	Investment in wood shredding equipment, co-investment in IHW facility civil work, and required equipment
	<b>Bin and fleets</b>		AED 65 m (2025) AED 30 m (2029)	AED 65 m (2025) AED 30 m (2029)	2025 2028	Investment in new collection/service vehicles, bins, and extra bins serving 2-bin system

Project investment    PSD required investment

CAPEX injection year

*Total: AED 351 m*

*AED 286 m*

1) CAPEX injection needed as 50% shareholder of the JV

# PSD should develop standalone P&L, balance sheet, and cash flow statements for each business line to track financial performance independently

Proposed financial reporting structure

## Current state:

### Lack of segregation in financial reporting



- Financial reports are consolidated without standalone P&L, balance sheets, or cash flow statements for individual business lines (e.g., MRF, CDW, collection)
- Limited visibility into the financial performance of each business line, hindering decision-making and profitability analysis

## Implement business line-specific financial reporting



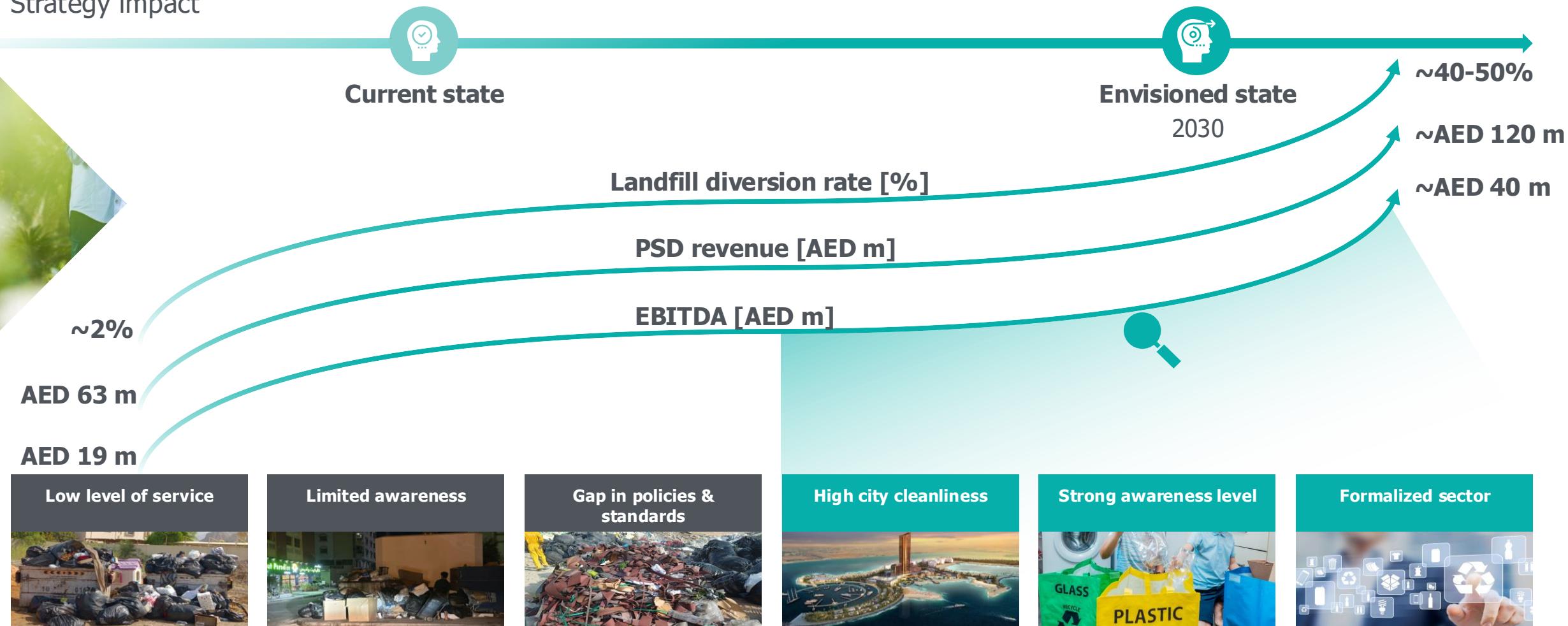
- Develop standalone P&L, balance sheet, and cash flow statements for each business line to track financial performance independently
- Standardize reporting processes across all business lines to ensure consistency and comparability

## B.4. Implementation plan

## **B.4.1. Introduction and summary**

# RAK waste management strategy is expected to deliver significant environmental and economic benefits

Strategy impact



# We identified 9 strategic initiatives and 5 enablers for RAK to implement over the next 3–5 years to achieve the 2030 strategic goal

vision

To deliver exceptional waste management services, promoting a sustainable environment for residents and tourists



## 1. Make city clean & reduce waste generation of MSW and CDW

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Strategic pillars

Enablers

Organization & governance

Regulations & standards

Awareness

Data management

Financial transparency

2030 targets



Total revenues of AED 120-130 mn



EBITDA margin of 30-35%



30-35% MSW landfill diversion rate

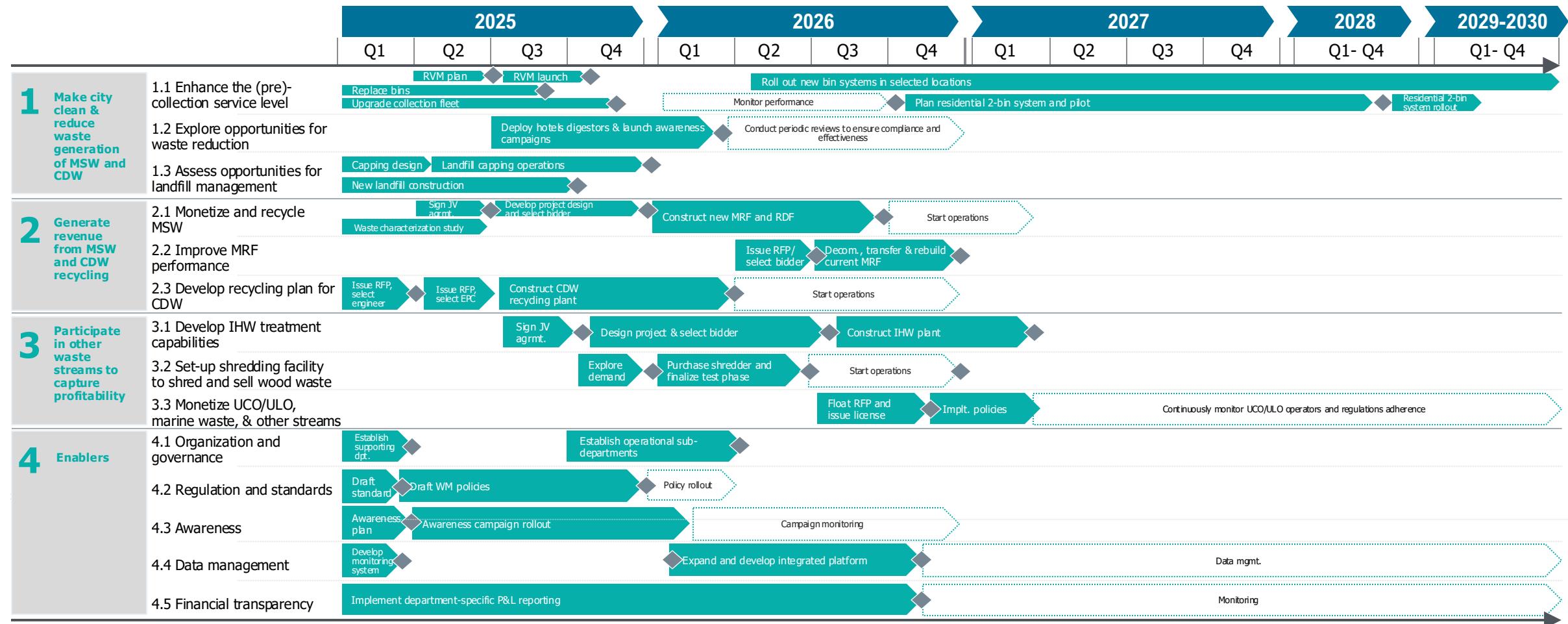


60-70% CDW landfill diversion rate



# The schematic below displays the consolidated high-level implantation roadmap of each initiative and each key milestones

## Consolidated high-level implementation roadmap



◆ Key milestone

## **B.4.2. Detail initiative implementation plan**

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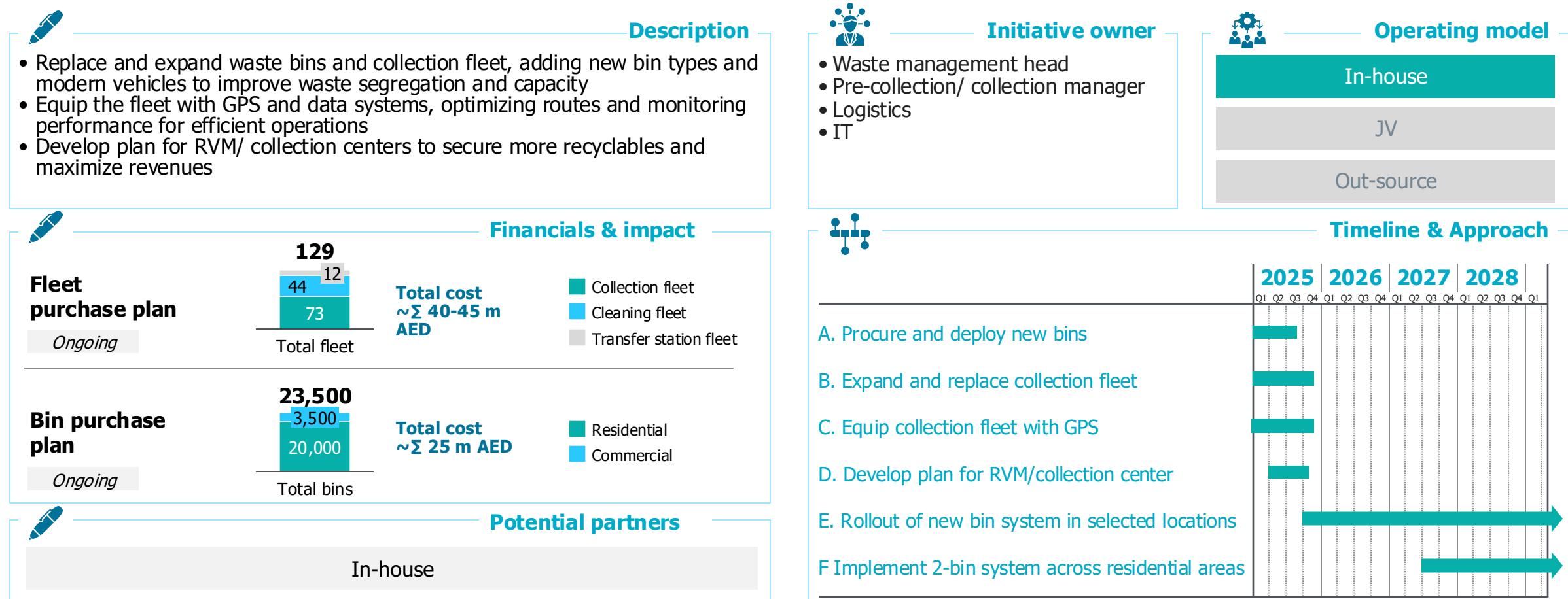


60-70% CDW landfill diversion rate



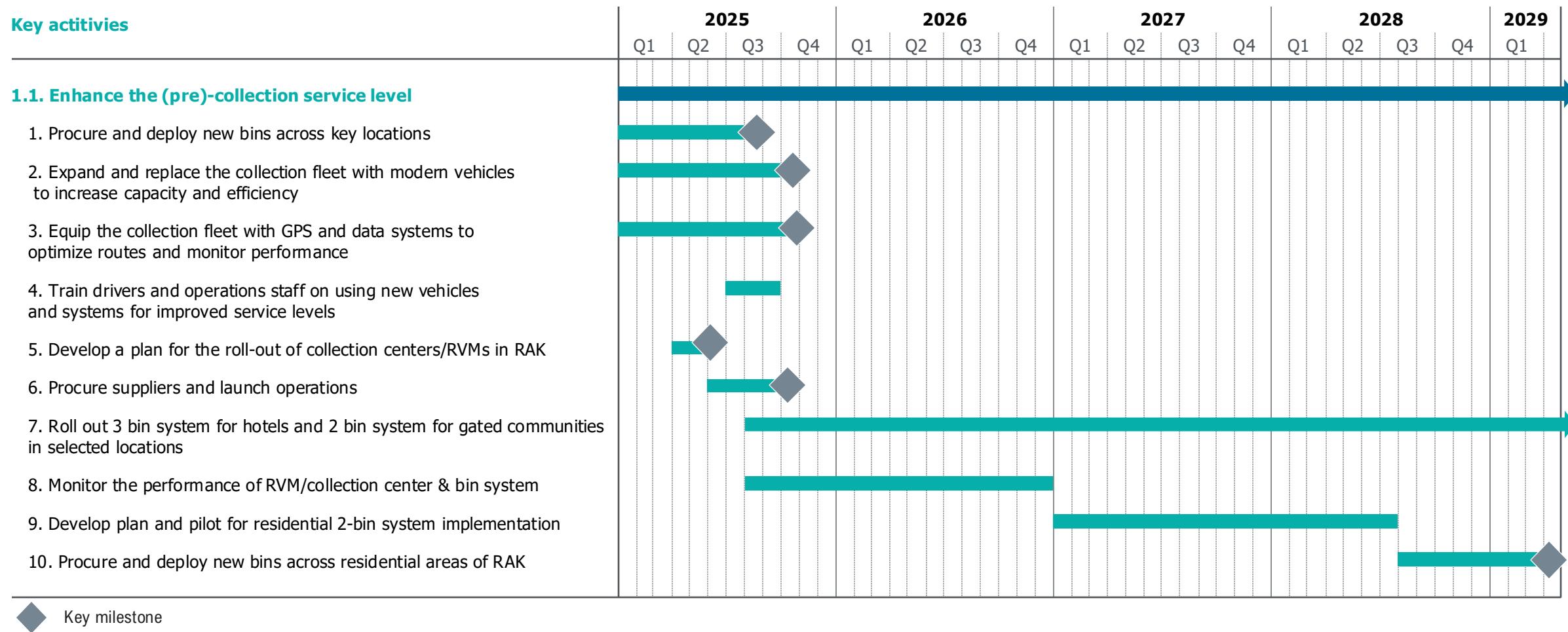
# Enhancing the pre-collection levels will focus on deploying new bins, expanding the collection fleet and developing a plan to maximize recyclables collection

## Opportunity card – 1.1 Enhance the (pre)-collection service level



# The initiative of enhancing the (pre)-collection service level will last for next 5 years, residential 2-bin system to be implemented in Q 3 2028

## High-level implementation roadmap | 1.1 Enhance the (pre)-collection service level



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# The roll out of decentralized and centralized organic waste digestors will start in Q4 2025 and be fully operational in Q3 2026

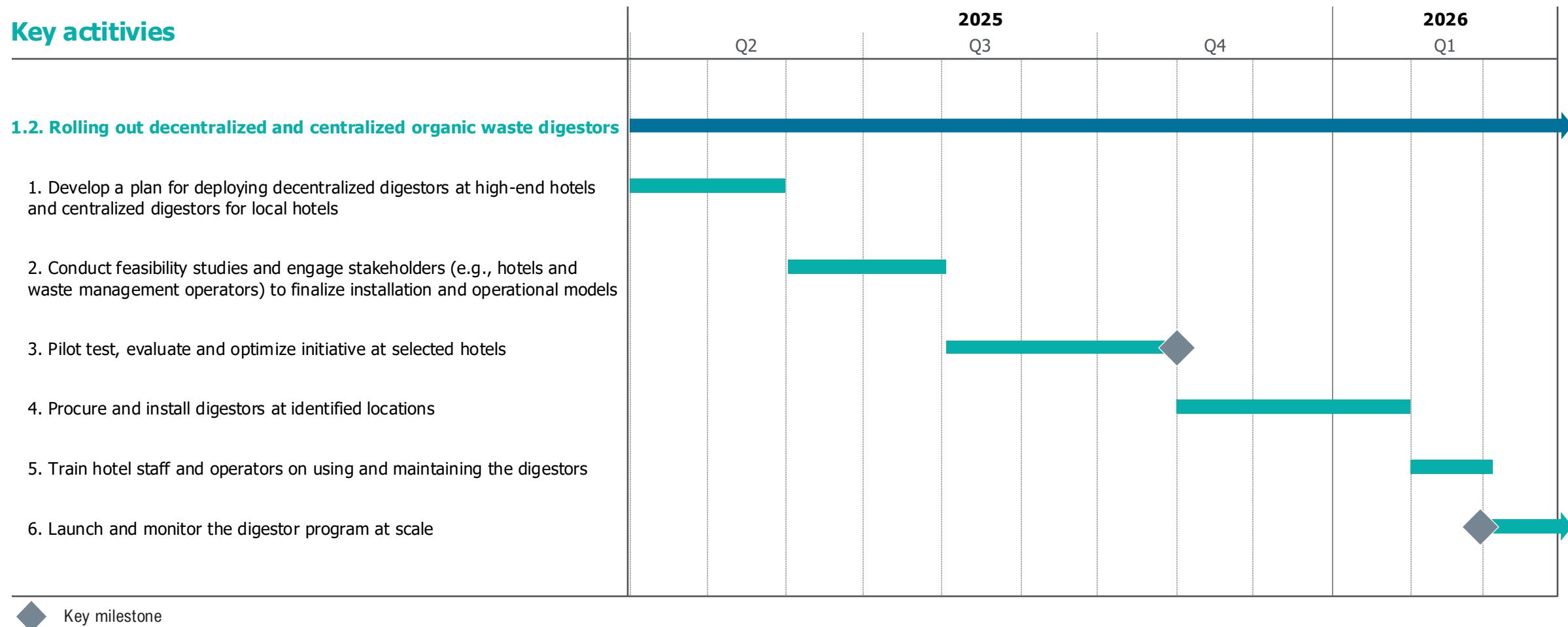
## Opportunity card – 1.2 Explore opportunities for waste reduction

 <p><b>Description</b></p> <ul style="list-style-type: none"> <li>• Develop a deployment plan, conduct feasibility studies, and engage stakeholders to finalize models for decentralized and centralized digestors</li> <li>• Pilot test, optimize, and install digestors at high-end and local hotels while training staff on operations</li> <li>• Launch the digestor program at scale and monitor performance to ensure effectiveness</li> </ul>	 <p><b>Initiative owner</b></p> <ul style="list-style-type: none"> <li>• Waste management head</li> <li>• Pre-collection/ collection manager</li> <li>• Awareness manager</li> </ul>	 <p><b>Operating model</b></p> <table border="1"> <tr> <td>In-house</td> </tr> <tr> <td>JV</td> </tr> <tr> <td>Out-source</td> </tr> </table>	In-house	JV	Out-source																											
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 <p><b>4-star hotels</b></p> <p><b>5 star hotels</b></p> <p><b>Potential partners</b></p> 																																

1) Pay As You Throw (PAYT)

# The initiative of exploring opportunities for waste reduction includes rolling out digestors which will take 12 months

High-level implementation roadmap | 1.2 Explore opportunities for waste reduction



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Enablers

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- Regulations & standards
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- Financial transparency

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30-35% MSW landfill diversion rate



60-70% CDW landfill diversion rate



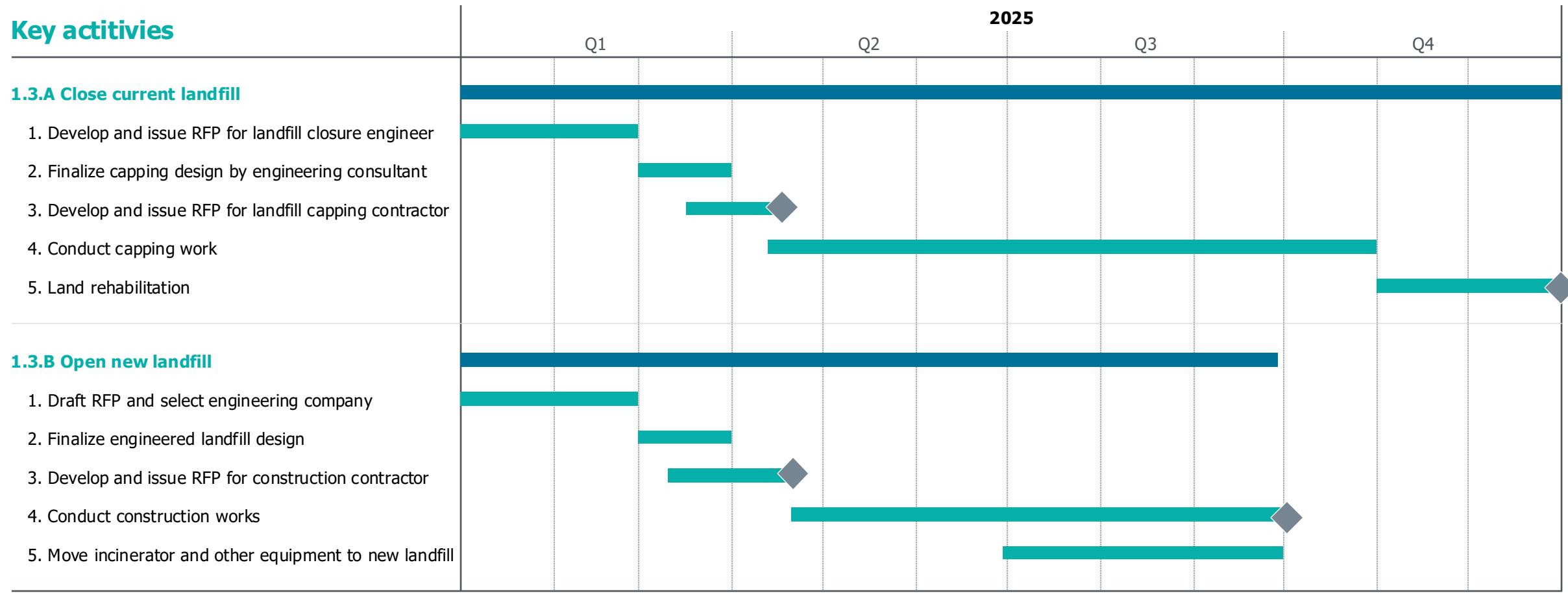
# The capping of the current landfill will finish in Q4 2025, whilst the new landfill will become operational at the end of Q3 2025

## Opportunity card – 1.3 Assess opportunities for landfill management

	Description		Initiative owner		Operating model
 <ul style="list-style-type: none"> <li>• Close the current landfill by developing and implementing a capping plan, ensuring compliance through leachate and gas management systems</li> <li>• Open a new engineered landfill by issuing RFPs, constructing the facility to international standards, and launching operations with proper waste and gas monitoring</li> </ul>			<ul style="list-style-type: none"> <li>• Waste management head</li> <li>• Landfill manager</li> </ul>		In-house
					JV
					Out-source
	Financials & impact				Timeline & Approach
	 <b>New landfill</b>	 <b>Landfill capping</b>	 <b>2025</b>		
<b>Area</b>	c. 300,000 <sup>1)</sup> m <sup>2</sup>	<b>Area</b>	c. 128,000 m <sup>2</sup>	<b>Q1</b>	
<b>CAPEX</b>	c. 55 m AED	<b>CAPEX</b>	c. 38 m AED	<b>Q2</b>	
				<b>Q3</b>	
				<b>Q4</b>	

# The new landfill is expected to open in Q3 2025, whilst the current landfill will be closed at the end of 2025

High-level implementation roadmap | 1.3 Assess opportunities for landfill management



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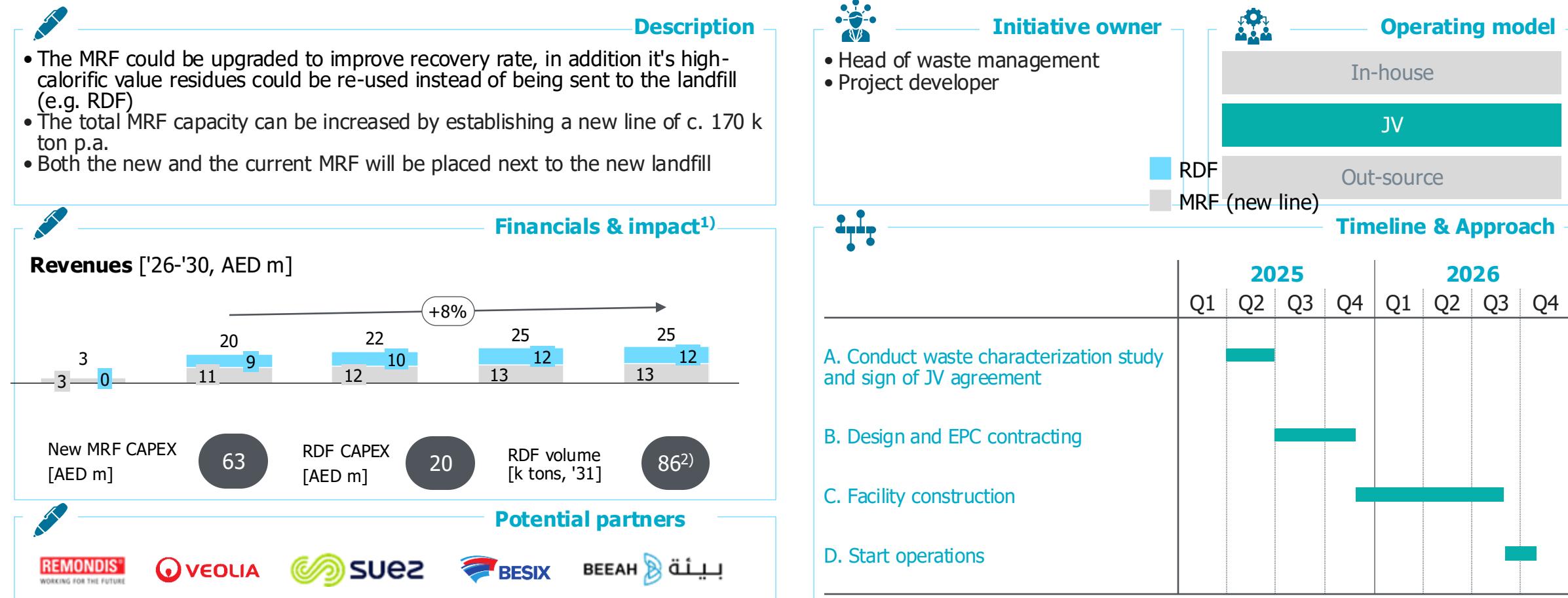


60-70% CDW landfill diversion rate



# Establishing the RDF and new MRF will take 18 months before the start of operations

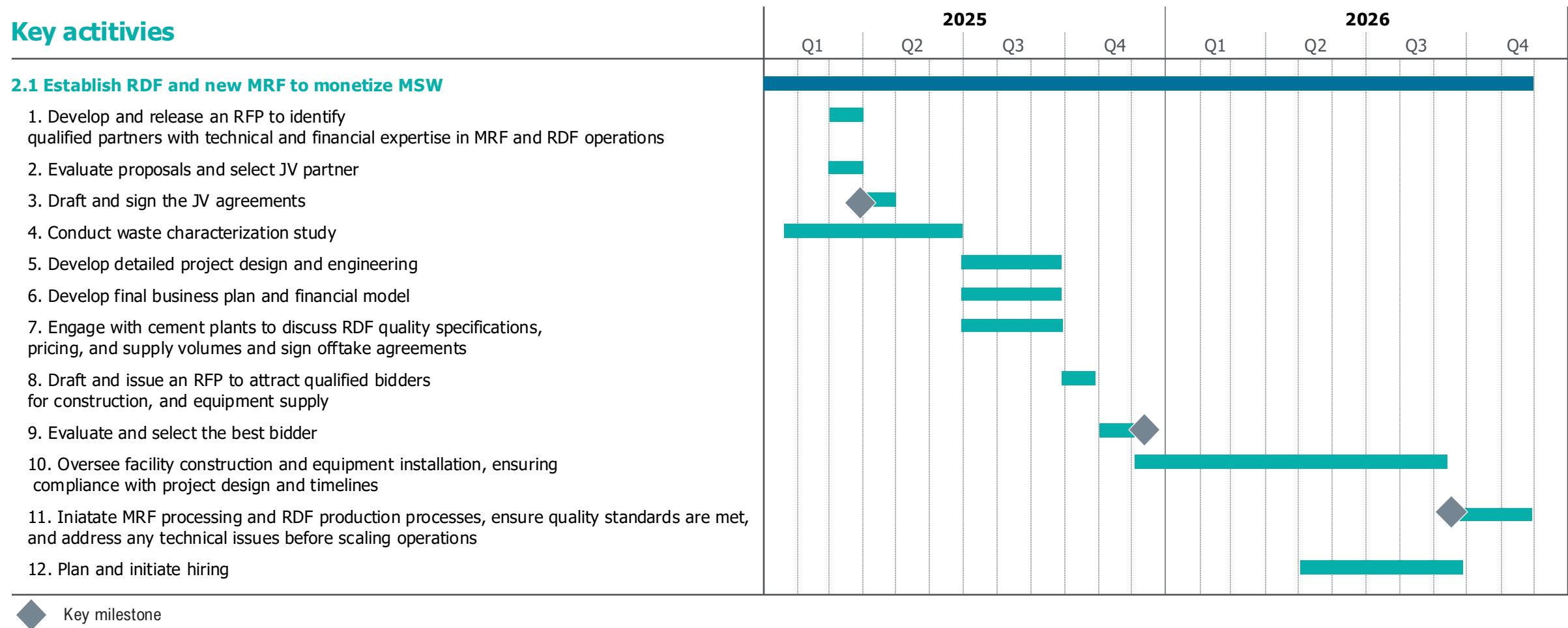
## Opportunity card – 2.1 Monetize and recycle MSW



1) Financials are for the project as a whole, JV ownership has not been taken into account; 2) Based on current MRF baseline recyclable volume c. 19 k tons (incl. 13 k ton cardboard trading), 15 k tons from new line 86 k ton RDF and c. 260 k ton of MSW collected

# The immediate next steps involve drafting the RFP and identifying the appropriate JV partner to move forward with the project development

## High-level implementation roadmap | 2.1 Monetize and recycle MSW



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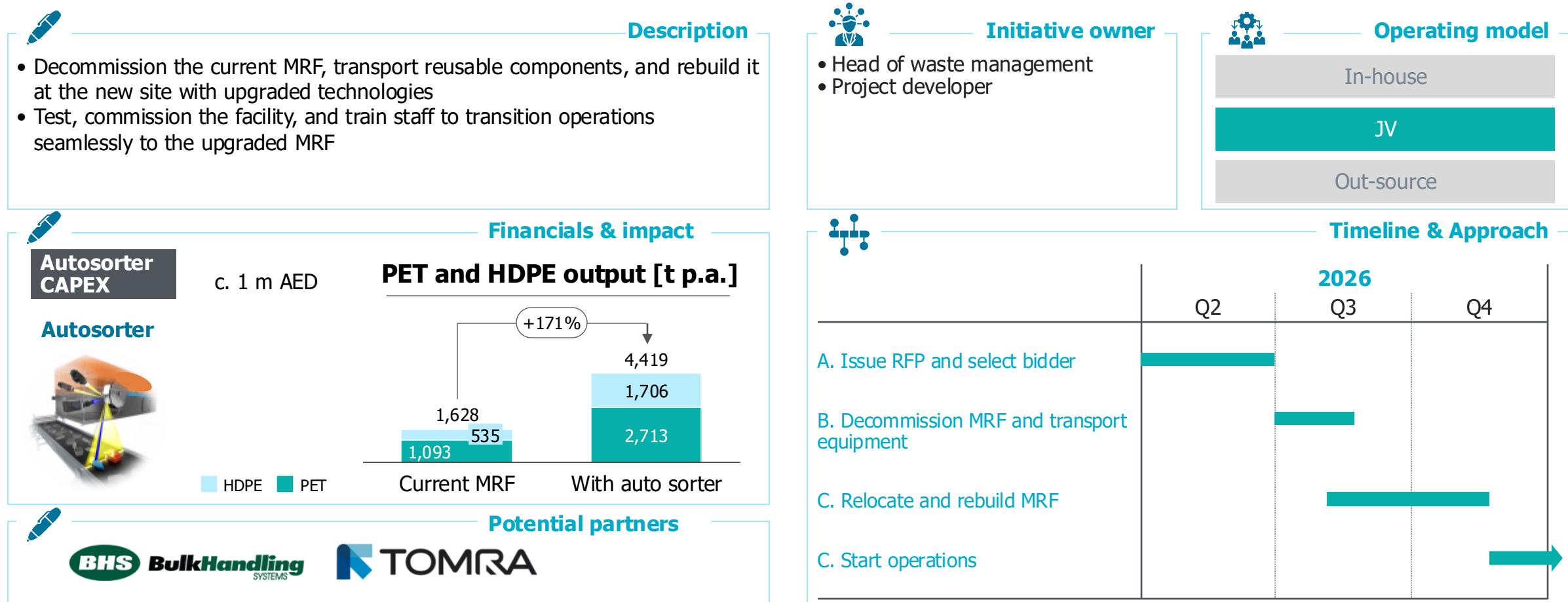


60-70% CDW landfill diversion rate



# After the new MRF line and RDF facility are completed, decommissioning of the existing MRF can start in Q2 2026, ensuring minimal disruption to operations

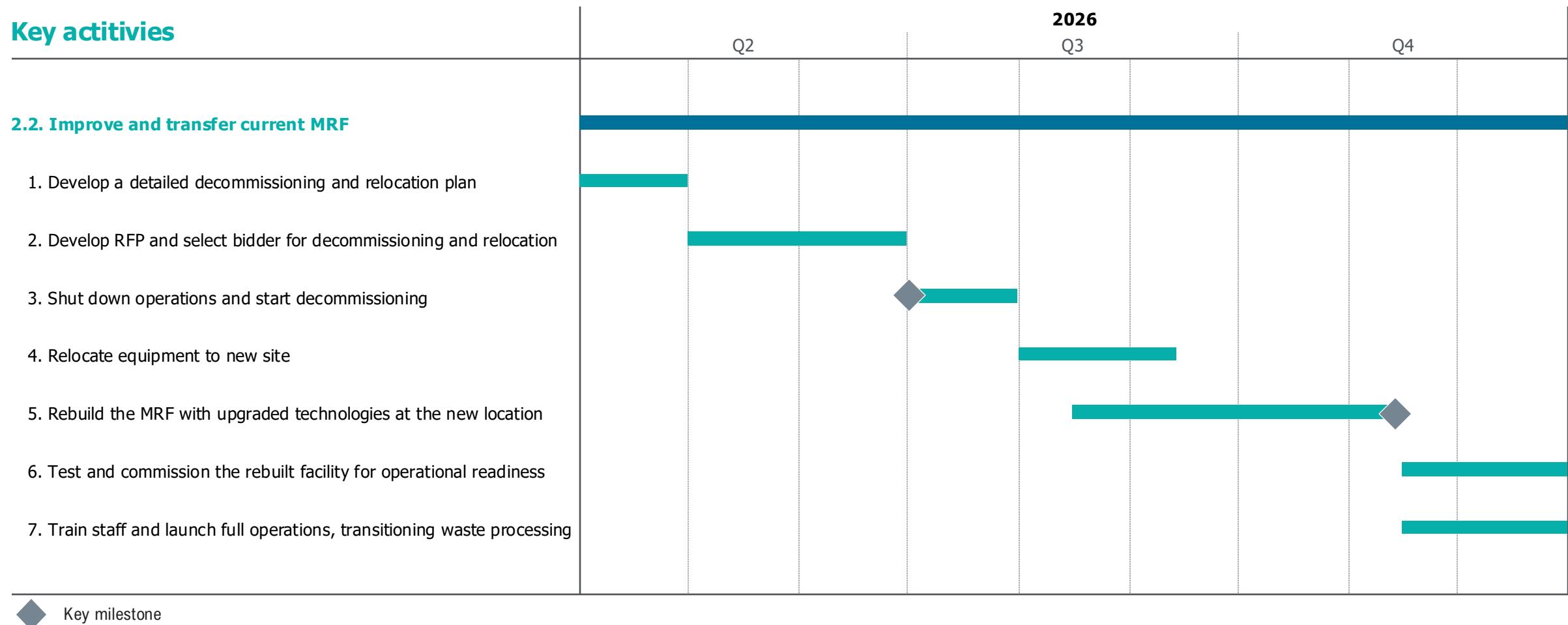
## Opportunity card – 2.2 Improve MRF performance



1) Based on current MRF baseline recyclable volume c. 19 k tons (incl. 13 k ton cardboard trading), 15 k tons from new line 86 k ton RDF and c. 260 k ton of MSW collected

# The MRF improvement will consist out of moving and upgrading the current MRF which will last c. 7 months

High-level implementation roadmap | 2.2 Improve MRF performance



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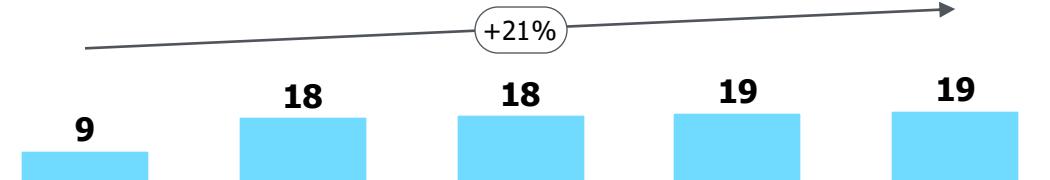


60-70% CDW landfill diversion rate



# Setting up the CDW recycling plant will start in Q1 2025 and will last c. 12 months before it will start its operations

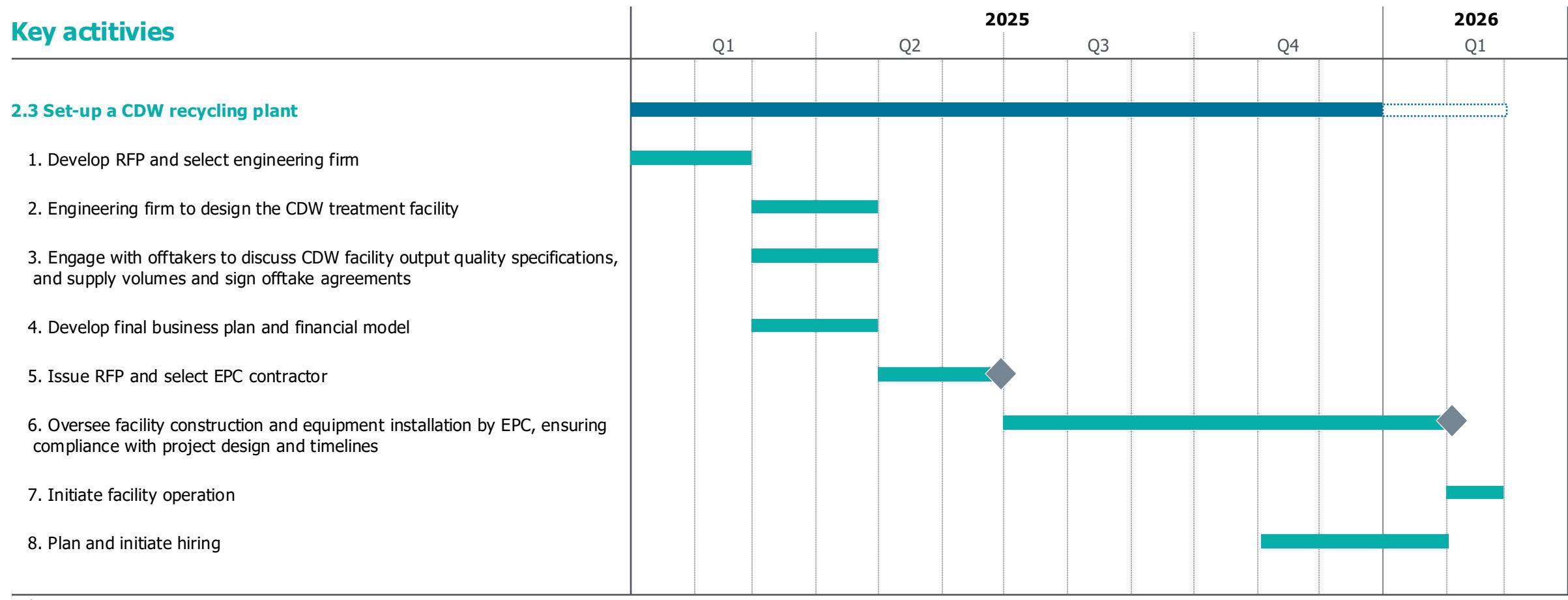
## Opportunity card – 2.3 Develop recycling plan for CDW

<p> <b>Description</b></p> <ul style="list-style-type: none"> <li>Develop and release an RFP to identify a contractor, select a bidder, and finalize agreements for construction and operation of the CDW recycling plant</li> <li>Engage with off-takers to finalize quality specifications, and supply agreements, supported by a detailed business plan and financial model</li> <li>Oversee construction, equipment installation, and commissioning to ensure compliance with design, timelines, and production quality standards</li> </ul>	<p> <b>Initiative owner</b></p> <ul style="list-style-type: none"> <li>Head of waste management</li> <li>Project developer</li> </ul>	<p> <b>Operating model</b></p> <table border="1"> <tr><td>In-house</td></tr> <tr><td>JV</td></tr> <tr><td>Out-source</td></tr> </table>	In-house	JV	Out-source																																
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<p> <b>Financials &amp; impact</b></p> <p><b>Revenues</b> ['26-'30, AED m]</p>  <table border="1"> <tr><td>9</td><td>18</td><td>18</td><td>19</td><td>19</td></tr> </table> <p><b>CAPEX</b> [AED m] 33</p> <p><b>Material offtake price</b> [AED] 14</p> <p><b>CDW facility processing volume</b> [k tons p.a.] 630</p>	9	18	18	19	19	<p> <b>Timeline &amp; Approach</b></p> <table border="1"> <thead> <tr> <th></th> <th colspan="3">2025</th> <th colspan="2">2026</th> </tr> <tr> <th></th> <th>Q1</th> <th>Q2</th> <th>Q3</th> <th>Q4</th> <th>Q1</th> </tr> </thead> <tbody> <tr> <td>A. Issue RFP, engage with offtakers and select bidder</td> <td colspan="2"></td> <td></td> <td></td> <td></td> </tr> <tr> <td>B. Oversee facility construction</td> <td colspan="4"></td> <td></td> </tr> <tr> <td>C. Initiate and oversee plant operations</td> <td colspan="5"></td> </tr> </tbody> </table>		2025			2026			Q1	Q2	Q3	Q4	Q1	A. Issue RFP, engage with offtakers and select bidder						B. Oversee facility construction						C. Initiate and oversee plant operations						
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1) Based on current MRF baseline recyclable volume c. 19 k tons (incl. 13 k ton cardboard trading), 15 k tons from new line 86 k ton RDF and c. 260 k ton of MSW collected

# CDW recycling plant is expected to start operation by end of Q1 2026

High-level implementation roadmap | 2.3 Develop recycling plan for CDW



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# Participating in other waste streams will most likely start in later in 2025 and later 2026

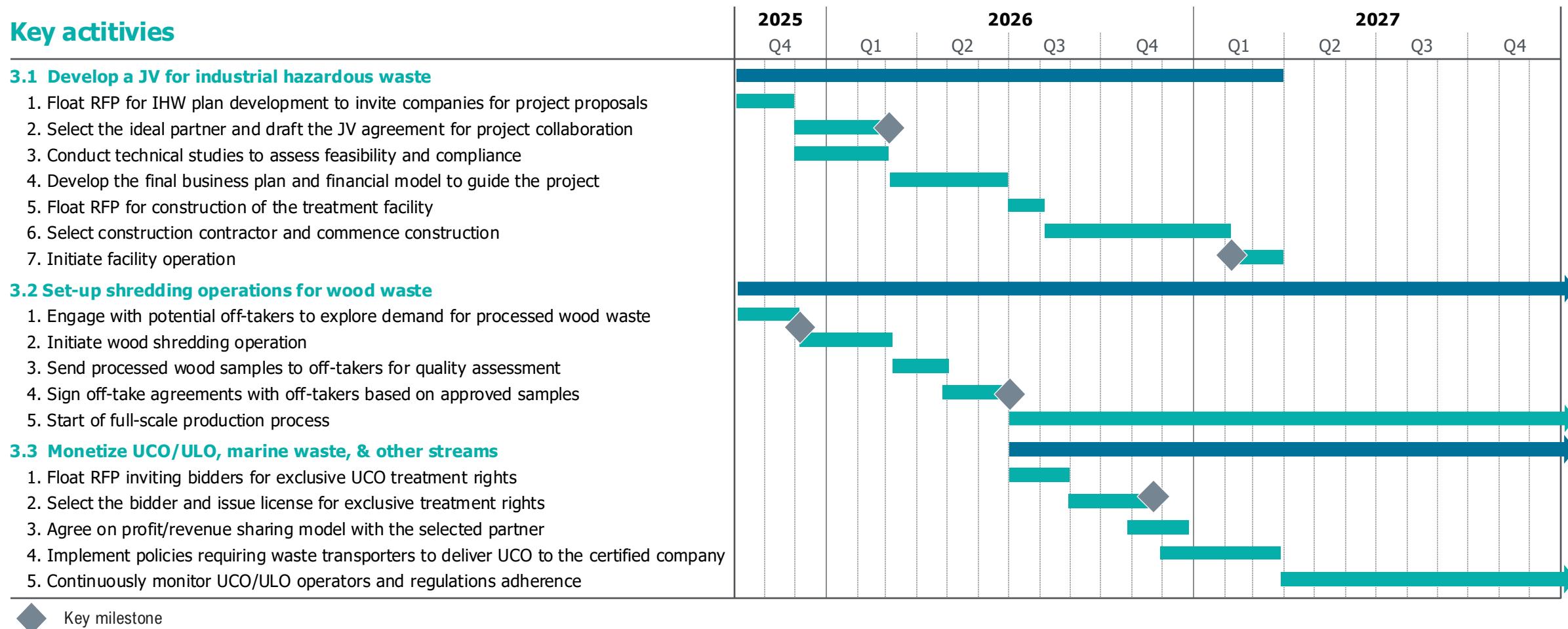
## Opportunity card – 3. Participate in other waste streams to capture profitability

 <b>Description</b> <ul style="list-style-type: none"> <li>Develop a JV for industrial hazardous waste by floating RFPs, selecting a partner, and building a treatment facility for safe disposal</li> <li>Set up wood waste shredding by engaging off-takers, purchasing shredders, and signing off-take agreements</li> <li>Monetize UCO/ULO by issuing treatment licenses, enforcing handover policies, and agreeing on profit-sharing models</li> </ul>	 <b>Initiative owner</b> <ul style="list-style-type: none"> <li>Head of waste management</li> </ul>	 <b>Operating model</b> <ul style="list-style-type: none"> <li>In-house</li> <li>JV</li> <li>Out-source</li> </ul>																																																																																			
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1) Used Cooking Oil (UCO), Used Lubricant Oil (ULO)

# The initiatives for engaging in other waste streams are expected to begin in H2 2026 and continue into 2027

High-level implementation roadmap | 3. Participate in other waste streams to capture profitability



# The strategy will focus on delivering exceptional waste management services, promoting a sustainable environment for residents and tourists

## vision

To deliver exceptional waste management services, promoting a sustainable environment for residents and tourists

## Strategic pillars



### 1. Make city clean & reduce waste generation of MSW and CDW

- 1.1 Enhance the (pre)-collection service level
- 1.2 Explore opportunities for waste reduction
- 1.3 Assess opportunities for landfill management



### 2. Generate revenue from MSW and CDW recycling

- 2.1 Improve MRF performance
- 2.2 Monetize and recycle Municipal Solid Waste
- 2.3 Develop recycling plan for Construction Demolition Waste



### 3. Participate in other waste streams to capture profitability

- 3.1 Develop industrial hazardous waste treatment capabilities
- 3.2 Set-up shredding facility to shred and sell wood waste
- 3.3 Monetize other streams through royalty fees (e.g. UCO) or direct sales (e.g. Tires)

## Enablers

Organization & governance

Regulations & standards

Awareness

Data management

Financial transparency

## 2030 targets



Total revenues of AED 120-130 mn



EBITDA margin of 30-35%



30-35% MSW landfill diversion rate

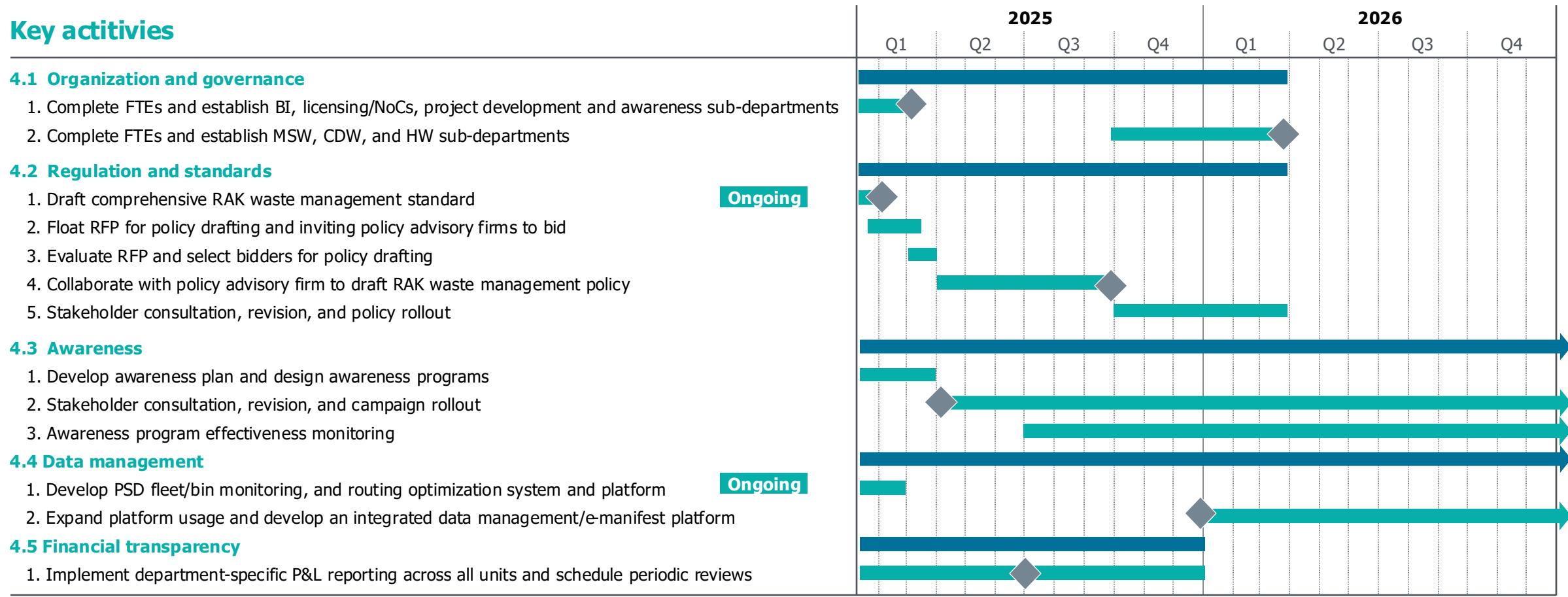


60-70% CDW landfill diversion rate



# Enablers will be implemented over 2 years, prioritizing organizational structures and regulations, with others dependent on operational initiative progress

## High-level implementation roadmap | 4. Enablers



◆ Key milestone

## B.5. Policy recommendation

## **B.5.1. RAK current policy status and selection framework**

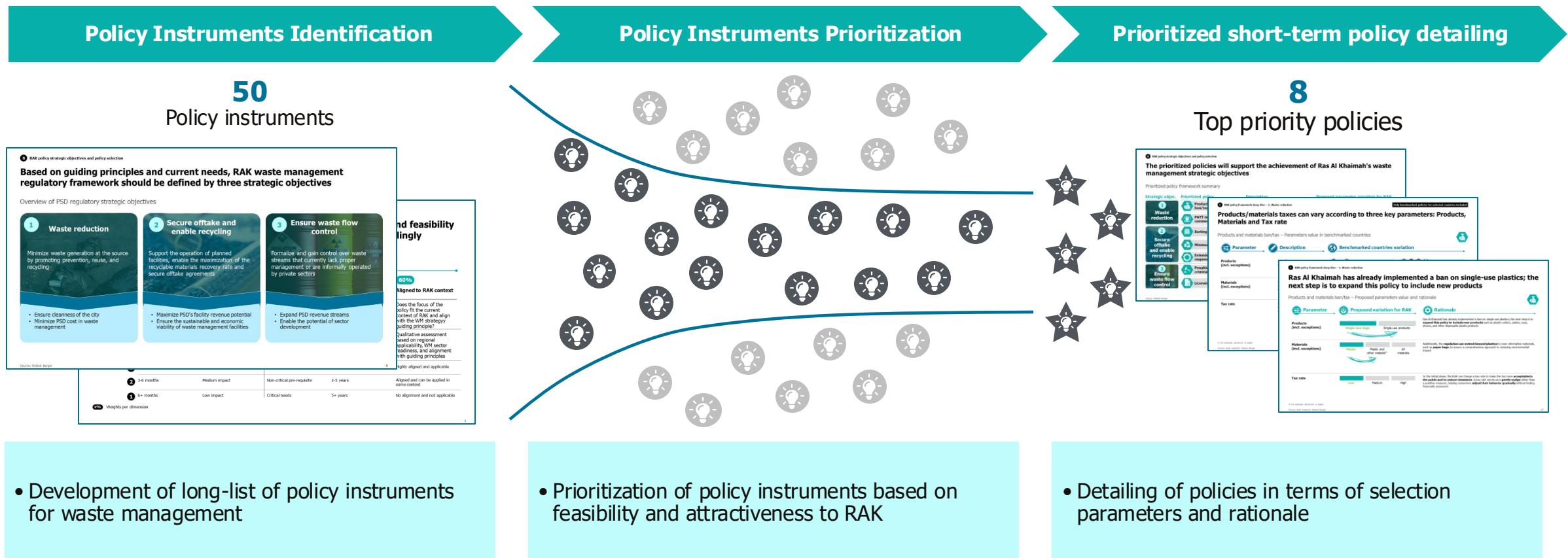
# RAK lacks detailed waste management regulations, policies, and standards, relying solely on federal-level guidelines and waste classification

Overview of the RAK WM regulatory framework



# We have developed an exhaustive long-list of policies, prioritized them based on multiple parameters and will estimate the impact of the main ones

Approach followed to identify, prioritize and assess policies' impact



# A scoring framework has been developed considering the impact and feasibility of each policy – The overall policy score has been calculated accordingly

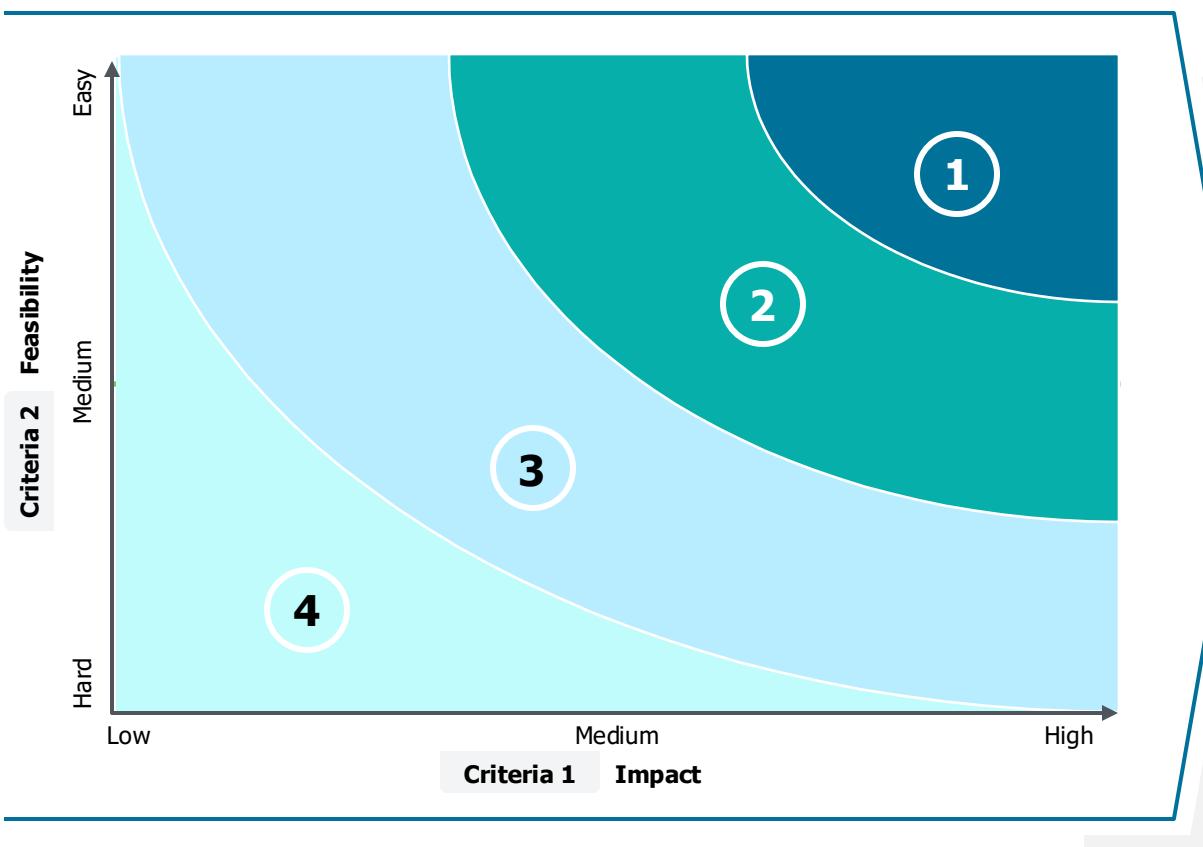
Policy instruments scoring mechanism

Dimension	In the policy impactful?		Is the policy feasible?		
Criterion	Time to Impact	Impact on strategic objectives	Pre-requisite	Timeline	Aligned to RAK context
Criterion description	Are the impact from the policy expected to occur instantaneously or slowly?	How significant will the policy's impact be on achieving PSD's waste management strategic objectives?	Are there dependencies to be considered in the launch of the policy?	What is the expected timeline for launching the policy?	Does the focus of the policy fit the current context of RAK and align with the WM strategy guiding principle?
Scoring method	Indicative quantitative assessment based on duration needed to see essential impacts	Qualitative assessment based on impact across cost optimization, service level improvement and waste reduction	Qualitative assessment based on market maturity and readiness to the policy introduction	Indicative quantitative assessment based on duration needed to start policy implementation	Qualitative assessment based on regional applicability, WM sector readiness, and alignment with guiding principles
Score	3 0-3 months	High impact	Market ready	1-2 years	Highly aligned and applicable
	2 3-6 months	Medium impact	Non-critical pre-requisite	2-5 years	Aligned and can be applied in some context
	1 6+ months	Low impact	Critical needs	5+ years	No alignment and not applicable

**x%** Weights per dimension

# We mapped the policy instruments on a two-dimensional matrix based on their respective impact and feasibility – four different categories were defined

Overview of prioritization matrix



## Policy Instruments Clusters

### 1 Top priority

Policies which are **highly match the current needs of the sector and come with significant, immediate benefits** (i.e., quick wins that address most pressing issues)

### 2 Second priority

Policies which **offer relatively high impact and relatively easy to implement** and certain degree of certainty in achieving their intended results

### 3 Later stage

Policies that may have an impact but **are not currently suitable for the RAK waste management sector** can be considered in the future to further refine the sector

### 4 Deprioritized

Policies that require **fundamental changes to RAK's waste management guiding principles** and overall sector context also have **limited impact**

## **B.5.2. RAK policy strategic objectives and policy selection**

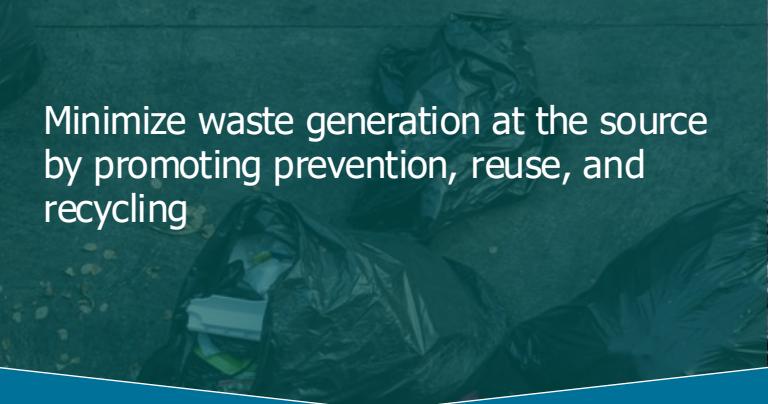
# Based on guiding principles and current needs, RAK waste management regulatory framework should be defined by three strategic objectives

Overview of PSD regulatory strategic objectives

1

## Waste reduction

Minimize waste generation at the source by promoting prevention, reuse, and recycling



- Ensure cleanliness of the city
- Minimize PSD cost in waste management

2

## Secure offtake and enable recycling

Support the operation of planned facilities, enable the maximization of the recyclable materials recovery rate and secure offtake agreements



- Maximize PSD's facility revenue potential
- Ensure the sustainable and economic viability of waste management facilities

3

## Ensure waste flow control

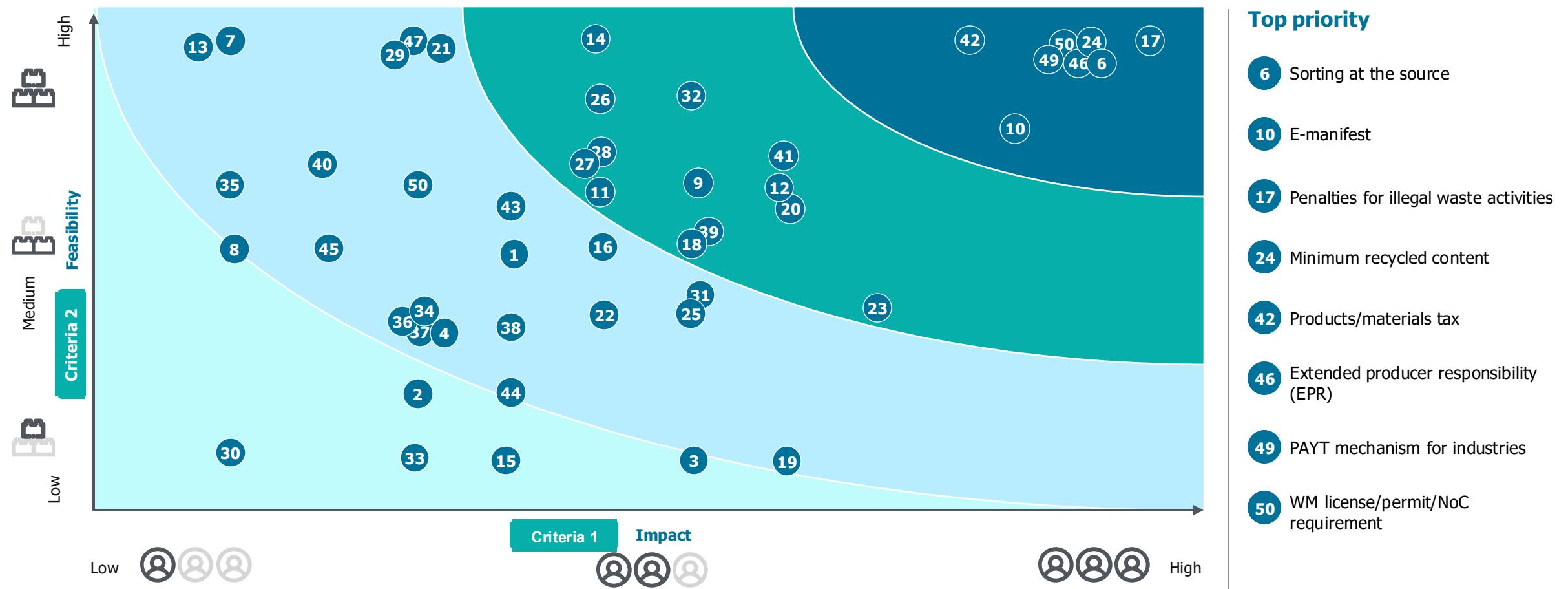
Formalize and gain control over waste streams that currently lack proper management or are informally operated by private sectors



- Expand PSD revenue streams
- Enable the potential of sector development

# Based on our policy prioritization framework, we have identified 8 top priority policies that can enable PSD shape and develop RAM WM sector

Policies prioritization and focus on the top priority policies



# The prioritized policies will support the achievement of Ras Al Khaimah's waste management strategic objectives

## Prioritized policy framework summary

Strategic objec.	Prioritized policy	Description	Proposed parameter variation for RAK	Benchmark and impact
1 Waste reduction	 <b>Products and materials ban/tax</b>	Introduce a ban or tax on products and materials that can not be recycled or harmful to the environment (e.g., plastic bags)	<ul style="list-style-type: none"> <li>Extend current single use plastic bag ban to other <b>single-used plastic products</b></li> </ul>	 Decrease of single-use plastic bags sold per person from 38 in 2016 to 9 in 2022
	 <b>Waste fee on commercial</b>	Impose fee on commercial waste generators based on the amount of waste generated to encourage waste reduction	<ul style="list-style-type: none"> <li>Implement a <b>multi-component fee structure</b></li> <li>Apply a fee on <b>waste volume generated from commercial entities</b></li> </ul>	 Reduction in the amount of waste generated by c. 24%
2 Secure offtake and enable recycling	 <b>Sorting at the source</b>	Set up clear sorting at the source (e.g., 3-bin system) to maximize recovery of materials	<ul style="list-style-type: none"> <li>Aim for a <b>2 bin system</b> in new developments and <b>3 bin system</b> in hotels</li> </ul>	 68% of packaging waste recycled—well above the EU's 55% target
	 <b>Minimum recycled content</b>	Mandate a minimum blend ratio of recycled materials in production manufacturing, construction, and energy supply	<ul style="list-style-type: none"> <li>Define a relatively low minimum recycled content <b>rate (10-15%)</b></li> <li>Apply policy on <b>construction material and fuel usage</b></li> </ul>	 Minimum 25% recycled content by 2025 for PET bottles and 30% by 2030
	 <b>Extended producer responsibility (EPR)</b>	Mandate producers to be responsible for the impact of their products in the final stage of its life cycle, after consumption	<ul style="list-style-type: none"> <li><b>Collaborate with MOCCAE</b> in developing the EPR framework from the <b>federal level</b></li> </ul>	 Increase in the quantity of recycled items by c. 46% since the start of enforcement
3 Ensure waste flow control	 <b>Penalties for illegal waste activities</b>	Establish penalties for individuals/corporates which engage in illegal activities related to the handling, disposal, and management of waste materials	<ul style="list-style-type: none"> <li>Impose <b>high fines</b> on both <b>individuals and companies</b> across the waste <b>value chain</b></li> <li>Base fines on <b>env. impact</b> and <b>violation frequency</b></li> </ul>	 25 cities impose fines on individual illegal waste disposal, facilitating the sorting at source
	 <b>WM license/permit/NoC requirement</b>	Set-up comprehensive licensing framework to be implemented for waste management in RAK	<ul style="list-style-type: none"> <li>Require licensing for all <b>waste activities and streams</b> throughout the <b>value chain</b></li> </ul>	 Ensure EAD has full control over the waste sector in Abu Dhabi region
	 <b>E-manifest</b>	Implement a technology-driven solution aimed at enhancing the tracking of waste materials and monitor the waste flow	<ul style="list-style-type: none"> <li>Implement E-manifest system for <b>all waste streams</b></li> </ul>	 Generation of savings for State and industry users of more than USD 50 m p.a.

### **B.5.3. RAK policy framework deep dive**

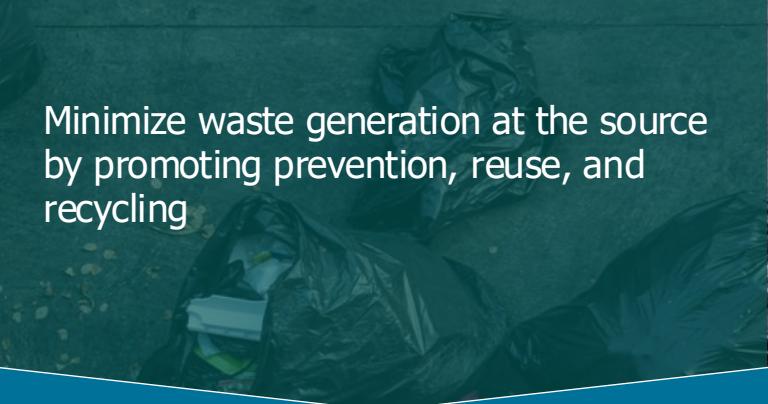
# Based on guiding principles and current needs, RAK waste management regulatory framework should be defined by three strategic objectives

Overview of PSD regulatory strategic objectives

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Minimize waste generation at the source by promoting prevention, reuse, and recycling

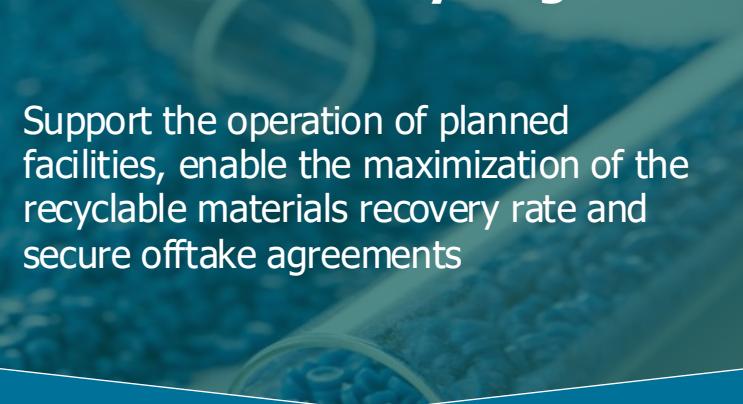


- Ensure cleanliness of the city
- Minimize PSD cost in waste management

2

## Secure offtake and enable recycling

Support the operation of planned facilities, enable the maximization of the recyclable materials recovery rate and secure offtake agreements



- Maximize PSD's facility revenue potential
- Ensure the sustainable and economic viability of waste management facilities

3

## Ensure waste flow control

Formalize and gain control over waste streams that currently lack proper management or are informally operated by private sectors



- Expand PSD revenue streams
- Enable the potential of sector development

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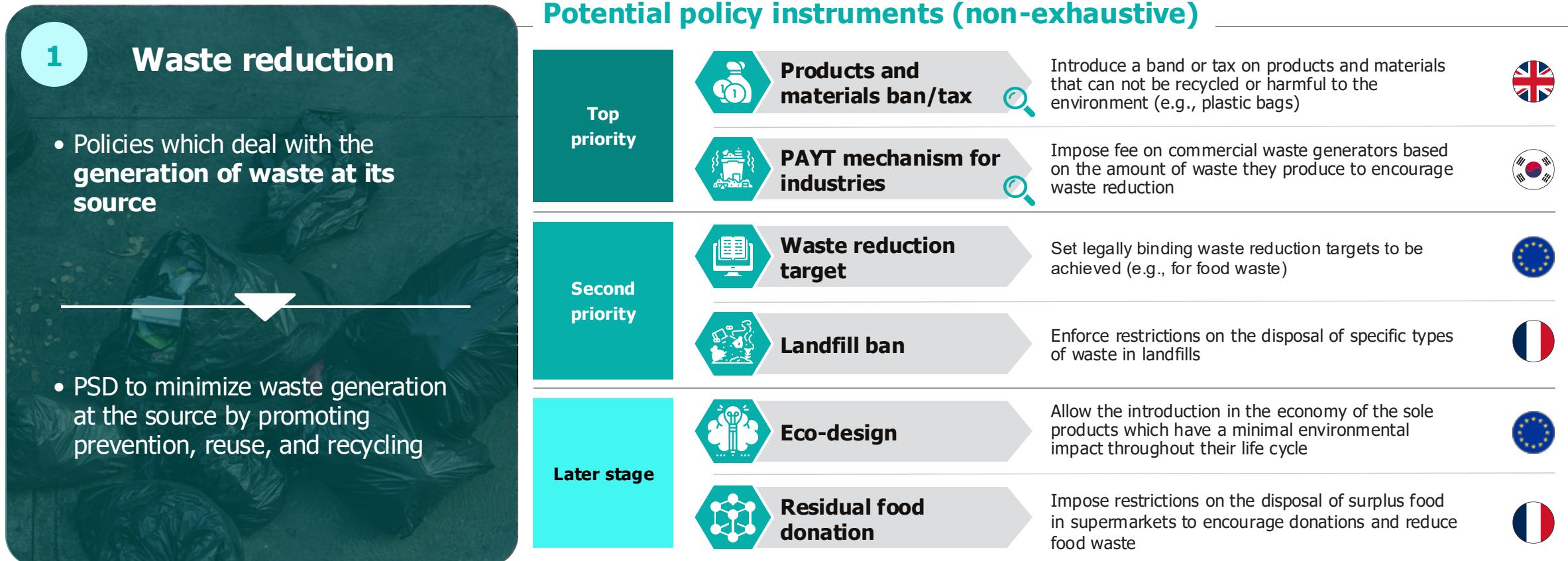
## Ensure waste flow control

Formalize and gain control over waste streams that currently lack proper management or are informally operated by private sectors

- Expand PSD revenue streams
- Enable the potential of sector development

# Policies focused on waste reduction enable PSD to control the types of waste entering RAK, thereby reducing WM costs by limiting waste generation

## Waste reduction policies



# Product and material bans forbid the circulation of specific items at env. protection focuses on products or materials difficult to recycle/ reuse

## Product and material ban – Key concepts

### Overview and rationale

- Instrument relies on introducing **bans/tax on products or materials** which should **not be allowed or limited** to circulate in a region/ country (i.e., forbidding the manufacture, sale, distribution, or use)
- Bans/tax are typically implemented to **address various concerns<sup>1)</sup>** relevant for the public – For the purpose of this policy, the ban/tax focuses on **environmental protection**
- The selected products or materials can be prohibited or limited from circulation for a **specified** or **indefinite** period of time

### Key decision factors for products/ materials identification



#### Recyclability

Products/ materials that are difficult or costly to recycle may be more likely to be banned to reduce environmental impact



#### Replaceability

Products/ materials that have readily available and practical alternatives may be prioritized to facilitate a smoother transition for consumers and industries



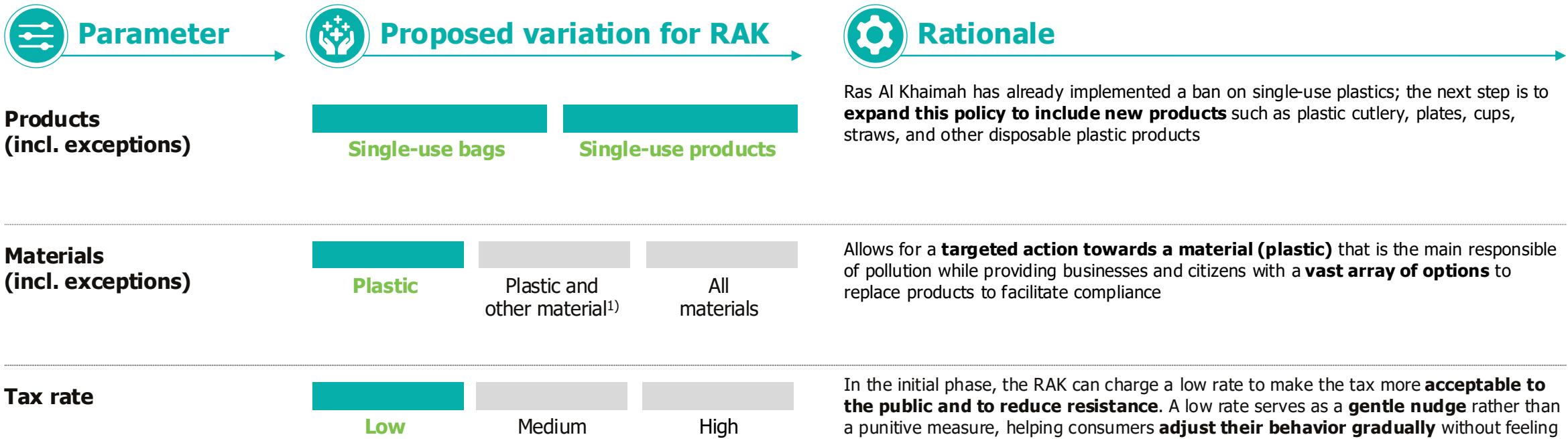
#### Reusability

Products/ materials with limited potential for reuse may be targeted for bans to encourage the use of more durable and long-lasting items

1) Including public health (e.g., asbestos), environmental protection, or safety (e.g., weapons)

# Ras Al Khaimah has already implemented a ban on single-use plastics; the next step is to expand this policy to include new products

Products and materials ban/tax – Proposed parameters value and rationale



1) For example, aluminum or paper

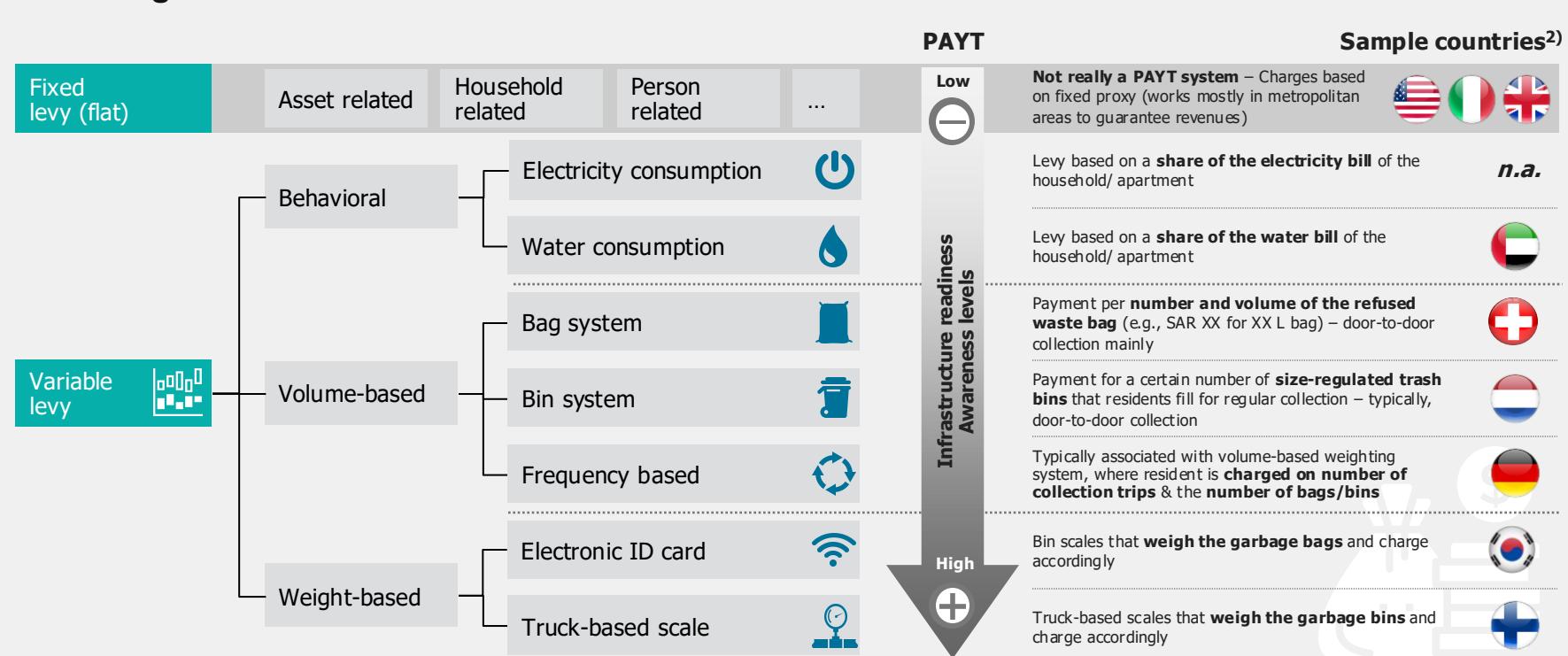
# PAYT is a waste management system that charges residents based on the amount of waste they dispose of – Multiple financing models exist

Pay as you throw mechanism – Key concepts

## Overview and rationale

- A "pay as you throw" (PAYT) mechanism is a waste management strategy where **households<sup>1)</sup> or commercial entities pay** for waste collection services based on the **amount of waste they dispose of**
- The systems require establishing a **pricing model that motivates behavioral changes** towards reducing waste generation while also improving its separation at the source
- Advanced PAYT systems require identifying individual users (e.g., using chips) to **track and measure the waste collected** from each user

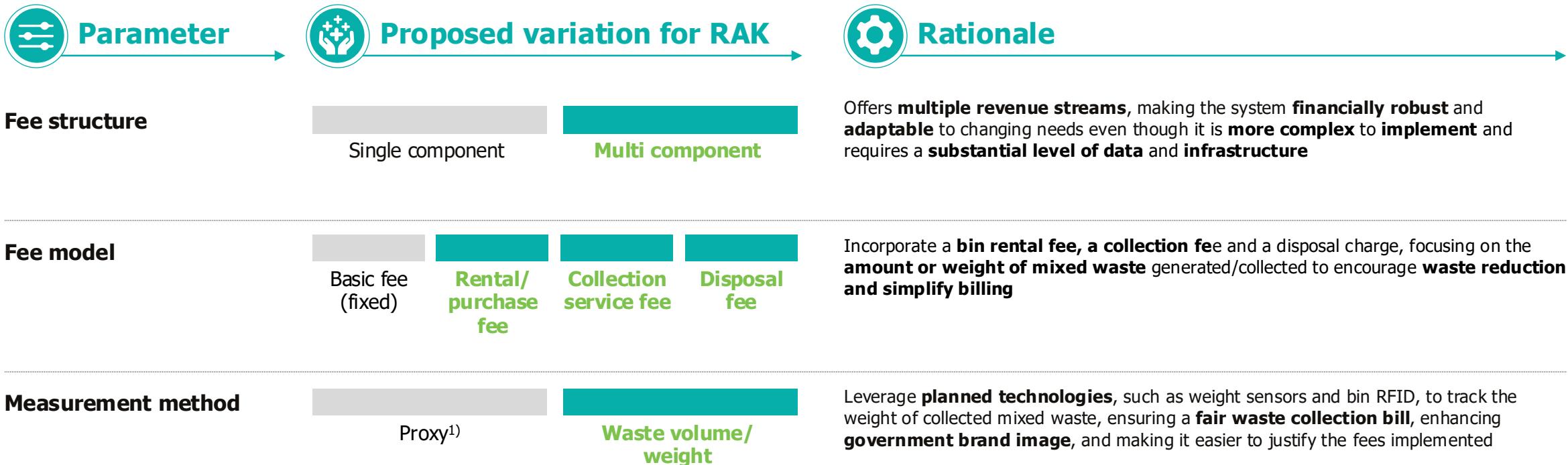
## Financing models



1) Can include small C&I entities; 2) Could vary per jurisdiction

# RAK should implement a PAYT mechanism that is relying on rental/ purchase fee and service fee while using waste volume/weight to derive generation levels

Pay as you throw mechanism for industries – Proposed parameters value and rationale



*The definition of a specific formula for fees calculation and the exact metrics for waste measurement require a separate study (i.e., project) – Consultations as a preliminary step in their definition*

1) Uses indirect measures (e.g., collection frequency, bin container volume, etc.) to estimate waste generation

# Based on guiding principles and current needs, RAK waste management regulatory framework should be defined by three strategic objectives

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## Ensure waste flow control

INHALATION  
RADIOACTIVE  
FLAMMABLE GAS

Formalize and gain control over waste streams that currently lack proper management or are informally operated by private sectors

- Expand PSD revenue streams
- Enable the potential of sector development

# Policies focused on offtake and recycling support the maximization of recycling feed stock and ensure the offtake market for PSD's planned facilities

## Waste reduction policies

### 2 Secure offtake and enable recycling

- Policies which deal with the **flow of the waste**
- Policies mainly focusing on enabling the **waste material recycling and recycling operation**

- PSD to ensure the **sustainability and economic viability** of the planned facilities while **maximizing revenue generation**

### Potential policy instruments (non-exhaustive)

<b>Top priority</b>	 <b>Sorting at the source</b>	Set up clear sorting at the source (e.g., 3-bin system) to maximize recovery of materials	
	 <b>Minimum recycled content</b>	Mandate a minimum blend ratio of recycled materials in production manufacturing, construction, and energy supply	
	 <b>Extended producer responsibility (EPR)</b>	Mandate producers to be responsible for the impact of their products in the final stage of its life cycle, after consumption	
<b>Second priority</b>	 <b>Deposit Refund System</b>	Set up DRS to incentivize consumers to return their used packaging for re-use	
<b>Later stage</b>	 <b>Tax exemption</b>	Reduce taxes for manufacturers which incorporate lines to take on recyclable materials	
<b>Deprioritized</b>	 <b>Resource efficiency clusters</b>	Favor the formation of resource efficiency clusters (i.e., networks of companies that collaborate to promote resource efficiency and sustainability)	

Deep-dive on next slides

# Sorting at the source requires households and businesses to separate their waste into distinct categories before disposal

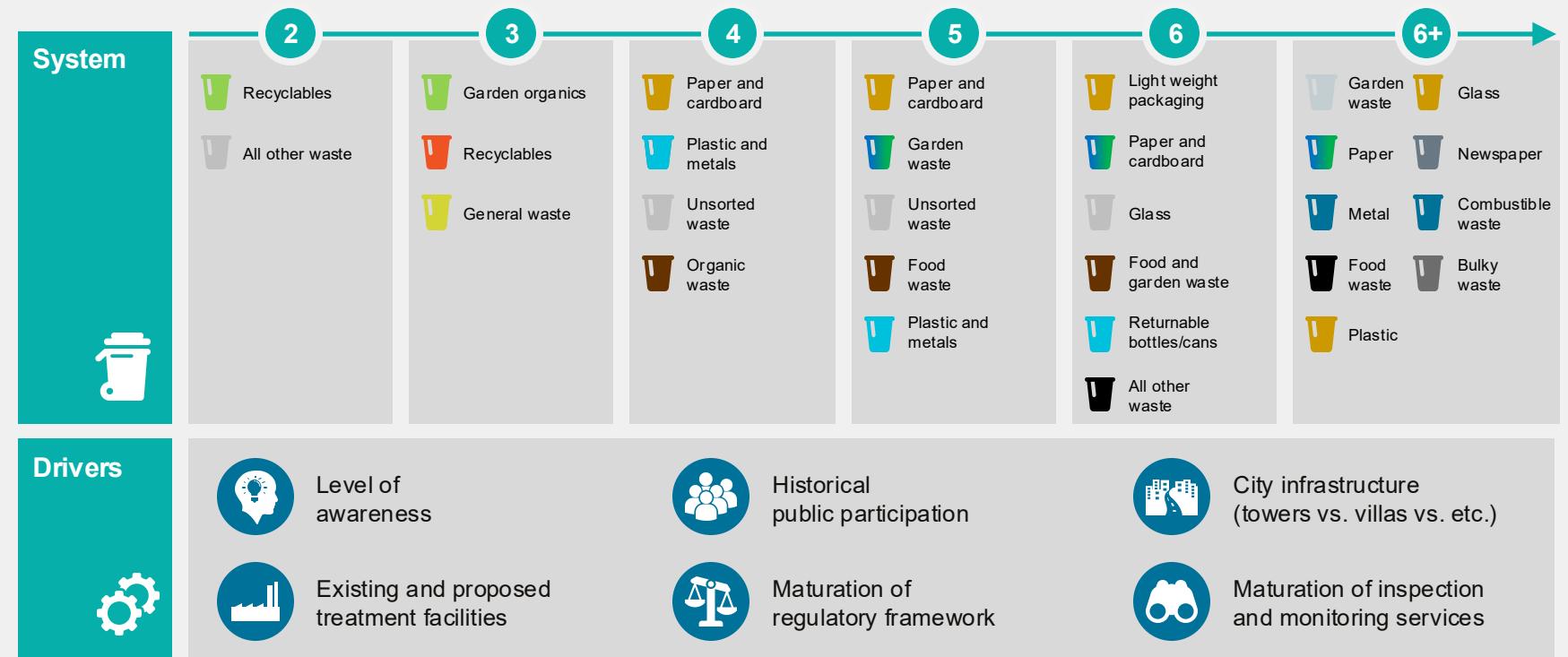
## Sorting at the source – Key concepts

### Overview and rationale

- Instrument requiring households and businesses to **separate their waste into distinct categories** before disposal
- Developed countries use different **color codes** for their systems depending on **multiple drivers** such as cities characteristics and objectives
- The primary aim of the policy is to **streamline the recycling process** and reduce **contamination** of recyclable materials

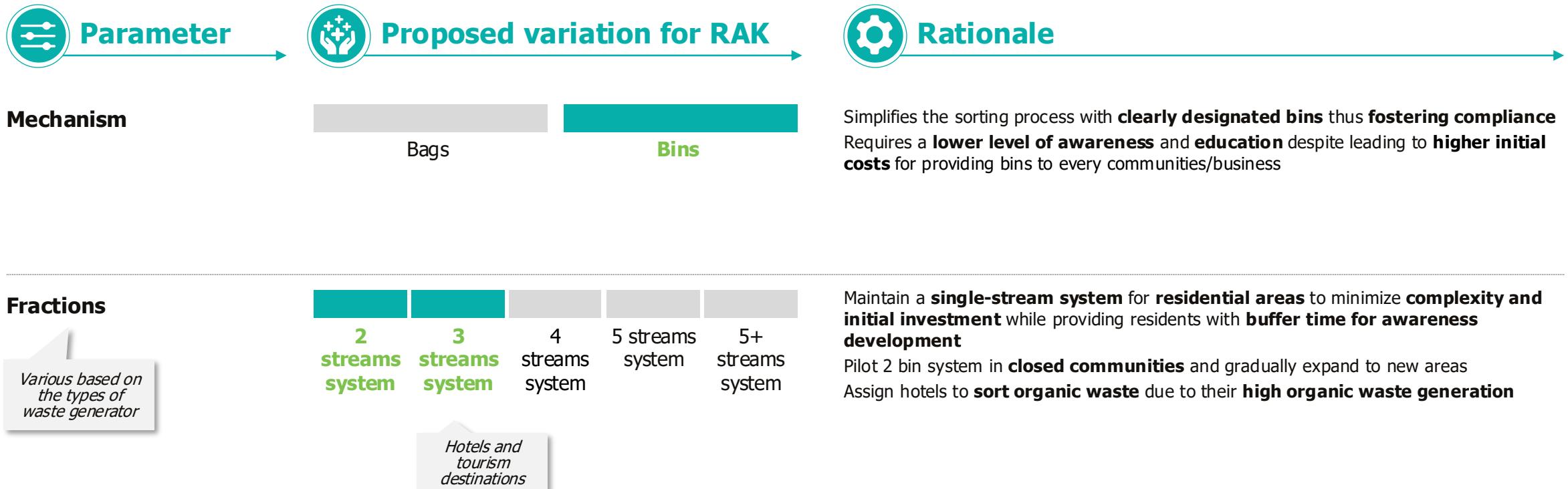


### Exemplary systems (illustrative)



# RAK should implement a sorting at the source system which relies on WM bins and mandates businesses, hotels, and private development to sort waste

Sorting at the source – Proposed parameters value and rationale



# The minimum recycled content policy mandates a set percentage of recycled material to be used in manufacturing processes to encourage offtake

## Minimum recycled content – Key concepts

### Overview and rationale

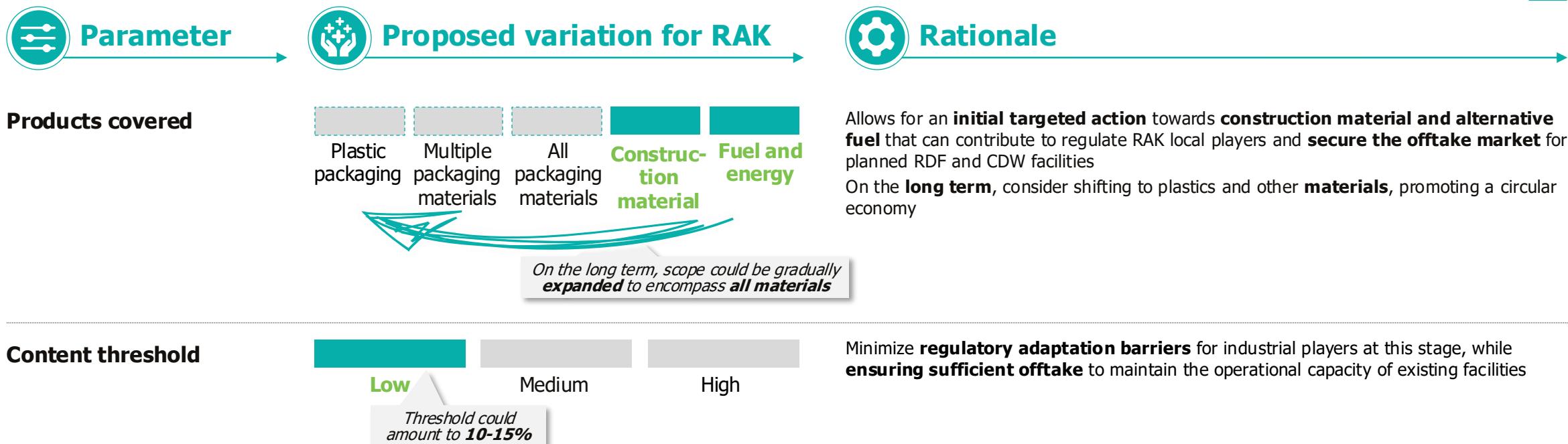
- Instrument introduces clear **requirements** and **thresholds** for recycled materials to be used in **manufacturing process**
- Thresholds can vary depending on the **type of material** and their **recyclability** with different requirements for different sectors
- It supports achieving **consistent recycling content usage** to reduce the reliance on virgin raw materials, ultimately boosting a **circular economy**

### Visual representation



## RAK should design a policy which initially focus on construction material and fuels – low tax rate to minimize adaptation barriers

Minimum recycled content – Proposed parameters value and rationale



# Two different EPR models are implemented today: classical model, in most countries and PRN model in UK and Poland

## EPR- Key concepts

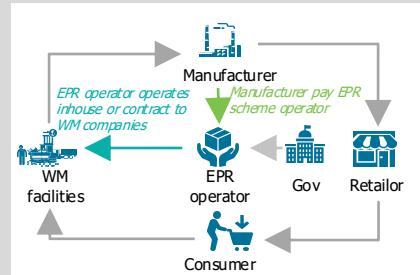
### Overview and rationale

- Instrument relies on **extending the producer's responsibility** to the **post-consumer stage** of a product life cycle
- Generally achieved by shifting the **economic burden of the cost of disposal** from the government to the **producer** of the product – It encourages **design for recycling** while **discouraging the use of toxic components** in products



1

### Classical EPR scheme



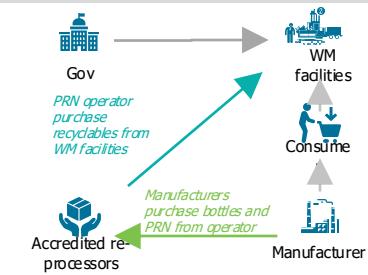
- Targeting all different waste types falling under EPR, not focusing on packaging only
- Involves all entities along the value chain (e.g.; collectors, transporters, recyclers) – unlike PRN model entirely dependent on recyclers

*EPR fee added on top of the price of products put in market to ensure collection, sorting and treatment*

- EPR regulations may cause an inflation in the prices of products under EPR (e.g.; packaging, WEEE, batteries, etc.)
- Expensive and complex compliance monitoring

2

### PRN model



- Compliance via PRNs is cheaper for producers vs. traditional EPR scheme
- Recyclers can choose to subsidize collection/ sorting costs more flexibly
- Streamlined obligation fulfillment process, clear target and open market approach

*Fee paid in the form of note, following recycling of waste provided by the producer to the recycling facility*

- Prices can suffer extreme fluctuations due to internal and external market conditions
- 'Pulling' material through system by recyclers – In practice, large share of collection and sorting cost burden lies with the municipalities/ consumers



*EPR scheme in different geographies*



# EPR will be developed by Ministry of Climate Change and Environment at federal level primary focus on packaging materials and WEEE

EPR – Proposed parameters value and rationale



## EPR by MOCCAE

- To tackle environmental challenges, foster integrated waste management, and drive the transition toward a circular economy, MOCCAE is set to launch a comprehensive framework for implementing Extended Producer Responsibility (EPR) in the UAE
- The implementation of EPR is anticipated to enhance waste treatment rates, reduce reliance on landfills, and accelerate the adoption of circular economy



**PSD can actively collaborate with MOCCAE by incorporating RAK's specific needs and context, contributing to the refinement of the UAE's EPR framework**

# Based on guiding principles and current needs, RAK waste management regulatory framework should be defined by three strategic objectives

Overview of PSD regulatory strategic objectives

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## Waste reduction

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2

## Secure offtake and enable recycling

Support the operation of planned facilities, enable the maximization of the recyclable materials recovery rate and secure offtake agreements

- Maximize PSD's facility revenue potential
- Ensure the sustainable and economic viability of waste management facilities

3

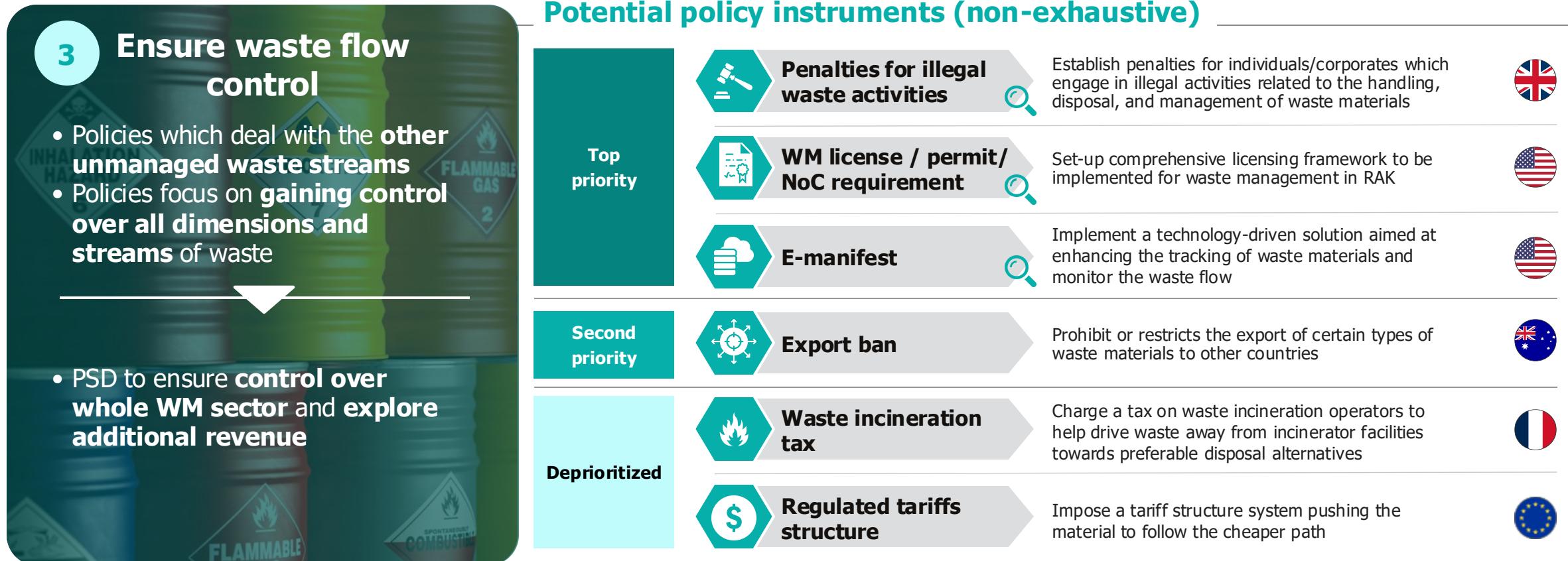
## Ensure waste flow control

Formalize and gain control over waste streams that currently lack proper management or are informally operated by private sectors

- Expand PSD revenue streams
- Enable the potential of sector development

# Policies focused on waste flow control will enable PSD to gain full control over all aspects of waste management in RAK

## Waste reduction policies



Deep-dive on next slides

# Penalties deter potential offenders from engaging in illegal waste activities – usually differentiated across waste types and tailored to countries' strategy

## Penalties for illegal waste activities – Key concepts

### Overview and rationale

- Instrument relies on the establishment of **penalties** for individuals/corporates which engage in **illegal activities** related to the handling, disposal, and management of waste materials
- Penalties are intended to **deter potential offenders** from engaging in illegal waste activities (e.g., illegal dumping, unauthorized waste treatment, etc.)



### Key insights

1

#### Fines structure according to waste types

General **split** of the fine's mechanism between **hazardous** and **non-hazardous** waste streams (to reflect environmental impact<sup>1)</sup>)

2

#### Fine types depending on environmental impact

Assignment of **hazardous** waste fines to **court** instead of immediate fines given the **higher impact on environment and society**

3

#### Tailoring of fines mechanism to strategy and infrastructure

**Enforcement** mechanism to **follow the strategy** and the **available infrastructure** of the country / city in addition to pain points



1) Common proxy used by countries include differentiation between hazardous and non-hazardous waste – However, this simplification might lead to distortions (e.g., severe environmental catastrophes can also be generated by non-hazardous waste)

# RAK should establish comprehensive and severe penalties for individuals and companies that are differentiated based on env. impact

Penalties for illegal waste activities – Parameters value in benchmarked countries



Parameter	Proposed variation for RAK	Rationale
<b>Differentiation Factor</b>	Undifferentiated	Based on env. impact <sup>1)</sup>
<b>Fine mechanism</b>	Fixed	Dependent on # of violations
<b>Fine type</b>	Administrative fines only	Administrative and court fines
<b>Violation type</b>	One value chain step	Multiple value chain steps
<b>Violator type</b>	Individuals or companies	Individuals and companies

1) Environmental impact could be estimated through various means including a "severity matrix" or a newly developed "environmental catastrophe rate"; 2) First-time offenders receive a relatively lower fine, allowing for education and correction, while repeat offenders face increased fines to reflect a pattern of non-compliance

# Waste management licensing ensures government oversight, stakeholder rights, and regulatory compliance in waste handling and disposal activities

Waste management license requirement– Key concepts

## Overview and rationale

- Instrument emphasizes the establishment or enhancement of waste management licensing frameworks for **corporations engaged in activities** such as **handling, disposal, and management of waste materials**
- Waste management licenses serve to **reinforce the government's regulatory authority** over waste materials, allocate rights to designated stakeholders, and ensure strict compliance with established waste management regulations

## Key questions to be addressed

1

**Who need a waste management license / permit / NoC?**

2

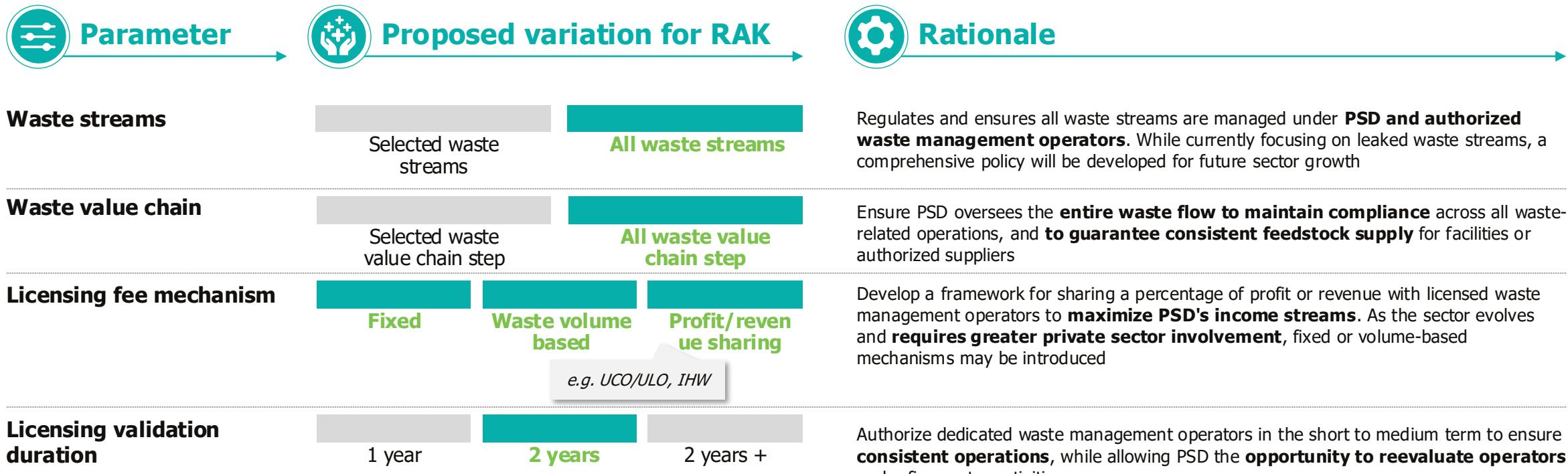
**Which department is responsible for the approval of the license / permit / NoC?**

3

**Who will enforce the compliance of licensed stakeholders?**

# RAK should establish comprehensive licensing framework to cover all waste streams and entire value chain with the waste volume/profit sharing

Licensing – Proposed parameters value and rationale



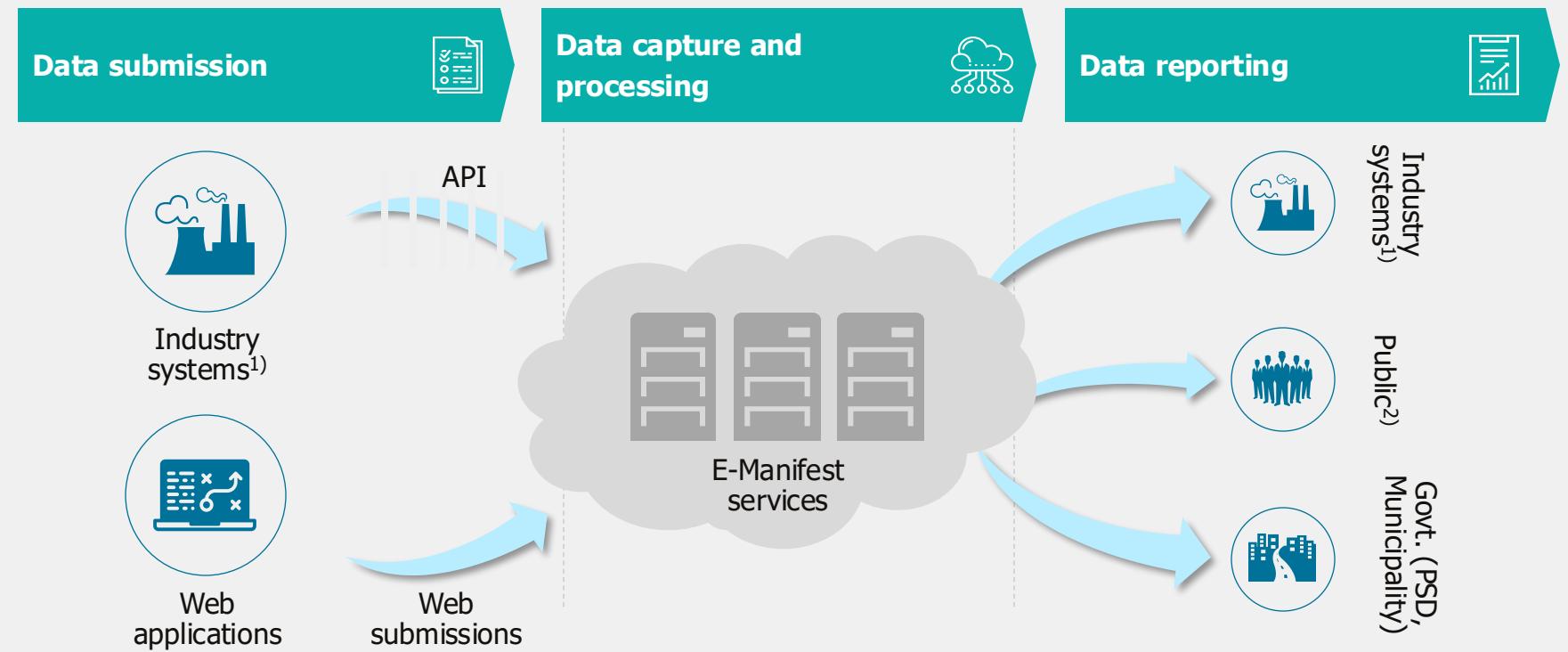
# The E-manifest provides a digital solution to track waste movements across the value chain efficiently fostering regulatory compliance

## E-manifest– Key concepts

### Overview and rationale

- Instrument relies on creating and mandating the use of a **standardized electronic form** that supports **waste tracking** throughout its lifetime by being filled/ updated after each transfer
- The instrument aims to:
  - Assist in data analysis and tracking** by providing govt./ authorities with a complete view of **the waste in circulation**
  - Save time and money** by replacing traditional paper forms with **easy-to-retrieve digital forms**

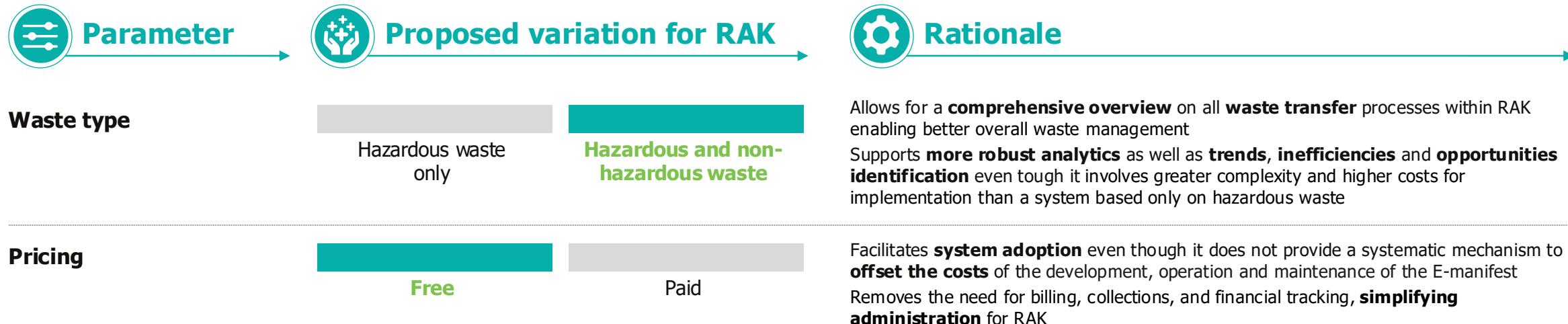
### Conceptual model



1) Various software and technological solutions used by companies involved in waste management which must be integrated with the E-manifest system; 2) Information usually available with a delay (e.g., 90 days)

# RAK should implement an E-manifest that tracks all types of waste – The system should be free for use for all WM players to facilitate adoption

E-manifest – Proposed parameters value and rationale



## **B.5.4. Policy prioritization scoring**

# The policy instruments have been prioritized across eight criteria falling under two dimensions; impact and feasibility (1/5)

Scoring of longlist of policy instruments (1/5)

Policy	Impact			Feasibility			
	Time to impact	Post deployment impact on strategic objective	Total	Pre-requisite	Timeline	Aligned to strategy	Total
Public reporting & accountability	3	1	1.6	2	2	1	1.4
Recycling targets	1	2	1.7	2	2	2	2
Sorting at the source	3	3	3	2	3	3	2.8
Mandatory recycling bins	3	3	3	1	1	1	1
Curbside Collection Programs	2	2	2	1	1	1	1
Inspection	3	2	2.3	2	2	2	2
E-manifest	2	3	2.7	2	2	3	2.6
Landfill ban	3	2	2.3	2	1	2	1.8
Export ban	3	2	2.3	2	3	2	2.2
Digital watermarks	3	3	3	1	1	1	1

# The policy instruments have been prioritized across eight criteria falling under two dimensions; impact and feasibility (2/5)

Scoring of longlist of policy instruments (2/5)

Policy	Impact			Feasibility			
	Time to impact	Post deployment impact on strategic objective	Total	Pre-requisite	Timeline	Aligned to strategy	Total
Deposit Refund System	3	3	3	1	2	2	1.8
Regulated tariffs structure	2	2	2	1	1	1	1
Waste recycling subsidies	2	2	2	3	3	1	1.8
Penalties for illegal waste activities	3	3	3	3	3	3	3
De-centralized treatment subsidies	2	2	2	2	2	2	2
Waste incineration tax	3	2	2.3	1	1	1	1
Landfill tax	3	2	2.3	2	3	2	2.2
Recycling credits	3	3	3	2	2	1	1.4
CAPEX subsidies for WM facilities	1	2	1.7	3	3	1	1.8
Capacity building	1	2	1.7	3	3	2	2.4

# The policy instruments have been prioritized across eight criteria falling under two dimensions; impact and feasibility (3/5)

Scoring of longlist of policy instruments (3/5)

Policy	Impact			Feasibility			
	Time to impact	Post deployment impact on strategic objective	Total	Pre-requisite	Timeline	Aligned to strategy	Total
Minimum recycled content	3	3	3	2	3	3	2.8
Green procurement targets	1	2	1.7	2	2	2	2
CAPEX grants for encouraging off-taking	2	3	2.7	3	3	1	1.8
Special loans offerings	1	3	2.4	3	3	1	1.8
Grants for new off-take solutions	1	3	2.4	3	3	1	1.8
Feed-in-tariffs	3	3	3	2	2	1	1.4
Resource efficiency clusters	1	1	1	1	1	1	1
Tax exemption	1	2	1.7	2	2	2	2
Recyclable raw materials trading credits	2	3	2.7	2	2	2	2
Green procurement report	1	1	1	2	2	1	1.4

# The policy instruments have been prioritized across eight criteria falling under two dimensions; impact and feasibility (4/5)

Scoring of longlist of policy instruments (4/5)

Policy	Impact			Feasibility			
	Time to impact	Post deployment impact on strategic objective	Total	Pre-requisite	Timeline	Aligned to strategy	Total
Right to repair	3	1	1.6	2	2	1	1.4
Products-as-a-service mandate	3	2	2.3	1	1	1	1
Extended guarantees	3	1	1.6	3	1	1	1.4
Fines for planned obsolescence	3	1	1.6	3	1	1	1.4
Sharing/leasing/renting incentives	3	1	1.6	2	3	1	1.6
Products and materials ban/tax	3	3	3	2	2	3	2.6
Mandatory waste audits	2	2	2	2	2	2	2
Eco-design	1	3	2.4	2	1	1	1.2
Waste reduction targets	1	3	2.4	2	3	2	2.2
Subsidies for surplus food redistribution	3	1	1.6	1	1	3	2.2

# The policy instruments have been prioritized across eight criteria falling under two dimensions; impact and feasibility (5/5)

Scoring of longlist of policy instruments (5/5)

Policy	Impact			Feasibility			
	Time to impact	Post deployment impact on strategic objective	Total	Pre-requisite	Timeline	Aligned to strategy	Total
Waste auditing incentives	2	1	1.3	2	3	1	1.6
Food labelling	2	2	2	1	2	1	1.2
Extended producer responsibility (EPR)	3	3	3	3	2	3	2.8
PAYT mechanism for citizens	3	3	3	1	1	1	1
PAYT mechanism for industries	3	3	3	3	2	3	2.8
WM license/permit/NoC requirement	3	3	3	2	3	3	2.8
Carbon tax	3	2	2.3	2	2	1	1.4
Eco labelling	2	1	2	3	2	1	1.6
Corporate sustainability reports	1	3	1	3	3	1	1.8
Statutory requirements information	1	1	1.4	2	2	1	2.1



# Thank you!

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# WASTE MANAGEMENT DEPARTMENT – STRATEGY REPORT

We, the undersigned, formally endorse the WM PSD Strategy **2025** and authorize its implementation as outlined.

Name	Title	Signature	Date
Prepared by: Eng. Reem AlShehhi	WM and Sustainability Engineer		
Eng. Mohammed Abou Hemid	Waste Operations Manager		
Eng. Ali Alalkim	O&M Manager		
Eng. Raed Hilles	Director, Strategic Development Office		
Eng. Khalid Al Ali	Director General		
H.H. Sheikh Ahmed Al Qasimi	Chairman		

