

From Waste Management to Waste Markets: Infrastructure, Industry and Business Opportunities

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Purpose Statement

The purpose of this work is to synthesize a framework which transforms waste management services into a market; this synthesis harmonizes:

- Geography
- Waste streams
- Public services
- Business opportunities

Presentation Outline

- Waste Sources and Waste Types: The Service Provision Area (SPA) Analysis Method
- Identification and Categorization of Business Opportunities: The Service Provision Planning (SPP) Method
- Business Opportunities Timeline: The Resources Recovery Ladder (RRL) Method
- Business Opportunities Contractual Context: Project Delivery Methods (PDMs)

Waste Sources and Waste Types: The Service Provision Area (SPA) Analysis Method

Service Provision Areas (SPAs)

Egypt is divided to 300 geographically defined SPAs in 27 Governorates, each has a population around 300,000

Each SPA has the following characteristics:

- Urban structure
- Demographical structure
- Sociocultural characteristics
- Waste generation rates and composition
- Waste handling practices (informal and formal sectors)
- Waste management infrastructure

SPA Types:

- Urban
- Rural
- Urban/Rural

On the operational level, each SPA might be subdivided into a number of “Zones”. This is required for contractual and control reasons.

Service Provision Areas (SPAs): National Level

Number of SPAs in all Governorates: 300

Approximate Mixed MSW national daily generation: 60,000 ton/day

Approximate Mixed MSW annual generation: 22 million ton/year

Number of SPAs in Cairo Governorate: 31

Number of SPAs in Giza Governorate: 26

SPAs-based MSW infrastructure national needs*

Number of SPAs	Number of transfer stations/material recycling facilities	Number of treatment plants	Number of sanitary landfills
300	300	150	50







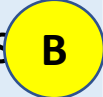

* New cities are not included

All numbers are approximate numbers

Generated Waste and Business Types

Population: 300,000 capita

Number of Household units: 60,000

MSW		Other waste	
Tonnage	Types of business opportunities	Types	Types of business opportunities
MSW Generation: 200 ton/day			
<ul style="list-style-type: none"> • OFMSW: 120 ton/day • Paper: 20 ton/day • Plastics: 24 ton/day • Metals: 4 ton/day • Glass: 6 ton/day • Textiles: 4 ton/day • Other: 22 ton/day 	<ul style="list-style-type: none"> • Supply contracts  • Construction contracts  • Service contracts  • Recycling businesses  	<ul style="list-style-type: none"> • Medical wastes • Industrial non-hazardous waste • Green waste • Construction/ demolition waste • Hazardous waste • Electronic waste 	<ul style="list-style-type: none"> • Supply contracts  • Construction contracts  • Service contracts  • Recycling businesses 

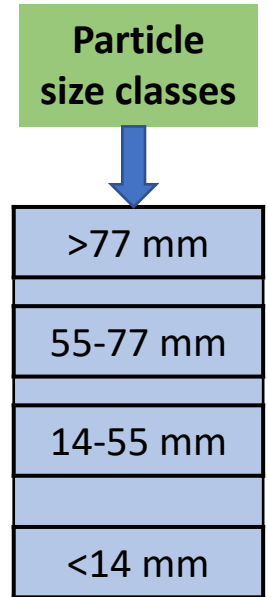
All numbers are approximate numbers

Classification of Waste Generated from a Typical SPA

No.	Waste Source	Typical facilities and activities generating wastes in SPAs
1	Residential	Includes single and multi-story houses and high density apartments. Type of solid waste includes: food waste, rubbish, ashes and special wastes.
2	Commercial	Includes stores, restaurants, markets, office building, hotels, medical facilities etc. Type of waste includes food waste, rubbish, ashes, demolition and construction wastes, hazardous wastes.
3	Institutional	Schools, hospitals, police stations, governmental centers etc. Waste similar to residential and commercial is produced in these establishments.
4	Municipal	The term Municipal Solid Waste (MSW) is used for mixed or source-separated waste generated from residential, commercial and institutional facilities
5	Industrial	Generated from repair shops, gas stations, small industries. Typical small industries include: clothing, furniture, printing, leather, food. Type of waste includes MSW, hazardous wastes and industrial non-hazardous waste
6	Open Areas	Includes streets, vacant lots, play grounds, beaches, recreational areas etc. Type of waste includes special waste and rubbish.
7	Inner-city utilities	It includes water and wastewater pumping stations and Scalping plants. Waste is principally composed of screenings, residual sludge and other minor components.
8	Green areas	It includes biomass generated from parks, gardens, urban agriculture, trees trimmings

MSW Categories and Characterization

Secondary categories	Primary categories	
1. Food waste 2. Yard waste 3. Other Biodegradable	← 1. Organics	16. Clothes (Synthetic) 17. Clothes (Non-synthetic) 18. Non-clothing textiles
4. Untreated 5. Treated	← 2. Wood	19. Ferrous Packaging 20. Non-ferrous Packaging 21. Miscellaneous Ferrous and Non-ferrous
6. High gloss paper/card and wallpapers 7. Paper/ card - packaging 8. Newspapers	← 3. Paper	22. Batteries/ Accumulators 23. Miscellaneous hazardous waste
9. PETE 10. HDPE 11. Low quality plastics 12. Other hard plastics	← 4. Plastics	24. Composite /Complex packaging 25. Composite/ Complex Non-packaging
13. Clear Glass Container 14. Color Glass Container 15. Miscellaneous Non Packaging Glass	← 5. Glass	26. waste of electrical and electronic equipment 27. Soil, Stones and other inerts 28. Household health care 29. <10mm 30. Liquid leftover and leachate
		← 6. Textiles
		← 7. Metals
		← 8. Hazardous
		← 9. Composite
		← 10. Mixed WEEE
		← 11. Inert
		← 12. HH Medical
		← 13. Fine particles
		← 14. Liquids



A. Chem. Composition

1. Carbon, 2. Nitrogen
3. Hydrogen, 4. Oxygen
5. Sulphur, 6. Chlorine
7. Phosphorous,
8. Heavy Metals 9. Water content, 10. Ash

The type and intensity of land uses – especially at the ground level – along with other community characteristics will determine the quantity of MSW generated, its categories and characterization.

Identification and Categorization of Business Opportunities : The Service Provision Planning (SPP) Method

Service Provision Planning (SPP): Scope

The Service Provision Plan specifies “WHAT” to be done, “HOW”, “WHEN”, “BY WHOM” and “AT WHAT COST” regarding four steps in MSW management: (1) Community level collection, (2) Transfer and Transport, (3) Treatment and Recycling and (4) Final Disposal.



**Waste Generation
and Community-
Level Management**

**Waste
Transfer and
Transport**

**Waste
Processing**

**Waste
Recycling**

**Waste
Disposal**

Service Provision Planning (SPP): Functions

The Service Provision Plan divides all works and waste management related activities into five separate FUNCTIONS (Fs). Each function specifies the spectrum of applied technologies and the associated business opportunities.



**Waste Generation
and Community-
Level Management**

**Waste
Transfer and
Transport**

F2

**Waste
Processing**

F3

**Waste
Recycling**

F4

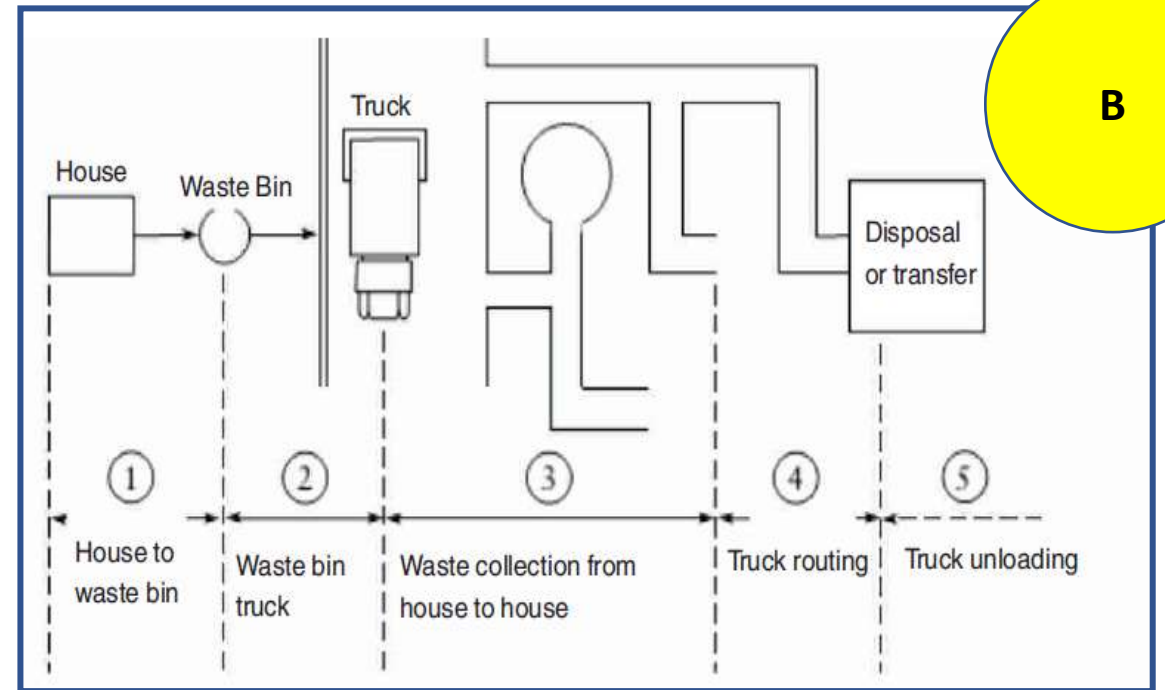
**Waste
Disposal**

F5

Function1: Waste Generation and Community-Level Management

Waste collection system defines: types of container, frequency of collection, types of collection services and routes as well as its user acceptance.

Most important for the design of a MSW collection system in SPA are: population, quantities of waste generated, waste composition, climate conditions, existing waste treatment facilities, public waste storage/disposal behavior, end product utilization, funding



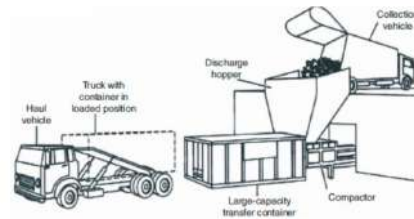
Function2: Waste Transfer and Transport

Transfer and transport refers to the means, facilities and equipment used to affect the transfer of waste from one location to another (usually to more distant location).

Typically, the waste from relatively small collection vehicle is transferred to larger vehicle and is transported to distant location for safe disposal or further processing.

Transfer stations

B



Material Recycling Facilities: Dirty, Clean and Hybrid

B

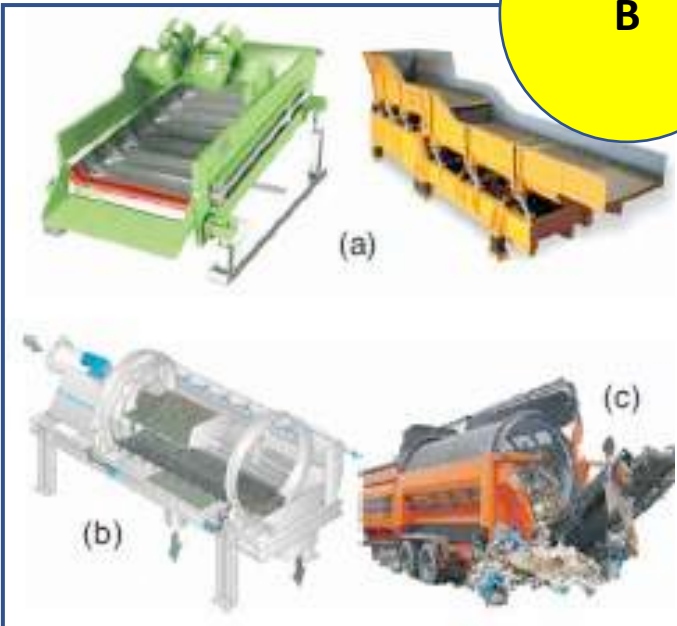


Function3: Waste Processing

Waste Processing for Efficiency Improvement:

- Densification
- Mechanical Shredding
- Component Separation
- Moisture Reduction

B



(a) Vibrating screens, (b) Rotary drum screen, © Trommel screen

Waste Processing for Material Recovery:

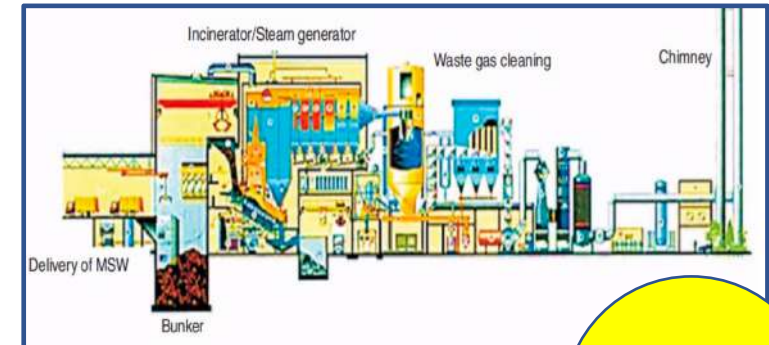
- Recovery of recyclables
- Recovery of the Energy Rich Fraction (ERF)
- Recovery of the biodegradable fraction in the form of compost

B



Waste Processing for Energy Production:

- Incineration
- Pyrolysis
- Bio-digestion



B








Function4: Waste Recycling







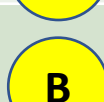
Category	Sub-sector
1	Collection and Transportation of All Types of Waste
2	Sorting and Densification of all Types of Waste
3	MSW Treatment and Disposal
4	Waste Glass Recycling
5	Metals Scrap Recycling
6	Paper Recycling
7	Textile Waste Recycling

Category	Sub-sector
8	Plastics Recycling
9	Rubber Waste Recycling
10	WEEE Recycling
11	Construction/Demolition Waste Recycling
12	Biomass Recycling
13	Reuse and Remanufacturing Industry
14	Support Businesses

- Scrap Metal Processors: Primarily handle metal scrap but also have diversified into other recyclable materials.
- End Use Manufacturers: Use recyclable materials as a feedstock to manufacture products.
- Multi-material Processors: Clean, sort, densify and process a variety of recyclable materials for shipment to end-use manufacturers.
- Recycling Collectors: Collect recyclables from homes, businesses, and industry.
- Equipment Dealers: Sell trucks, balers, and other equipment to recycling companies.
- Reuse Companies: Refurbish and reclaim laser cartridges, metal drums, and building materials.
- Oil and Chemical Recyclers: Reprocess and recycle chemicals, oils and paints.
- Textile Recyclers: Reuse or recycle textiles and fibers.
- Paper Stock Processors: Sort and bale paper and cardboard.
- Materials Brokers: Broker metal, paper, and plastic.
- Pallet and Wood Companies: Refurbish pallets and process scrap wood.
- Tire Recyclers: Retread, process or recycle tires.
- Education Groups: Provide recycling education.

Waste Recycling Industry Categorization*

Category	Sub-sector
1	Collection and Transportation of All Types of Waste 
2	Sorting and Densification of all Types of Waste 
3	MSW Treatment and Disposal 
4	Waste Glass Recycling
5	Metals Scrap Recycling 
6	Paper Recycling 
7	Textile Waste Recycling 

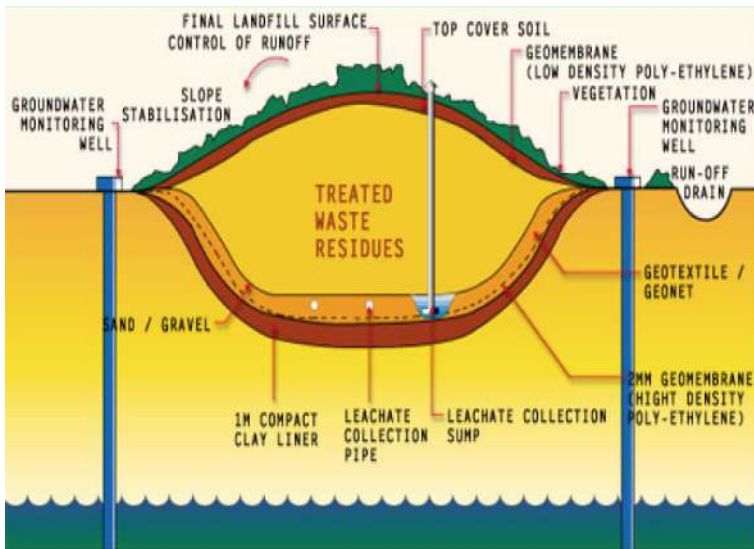
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14	Support Businesses 

*A.Gaber, Towards a Waste Recycling Industry in Egypt: Building Blocks and Proposed Categorization, May 2018

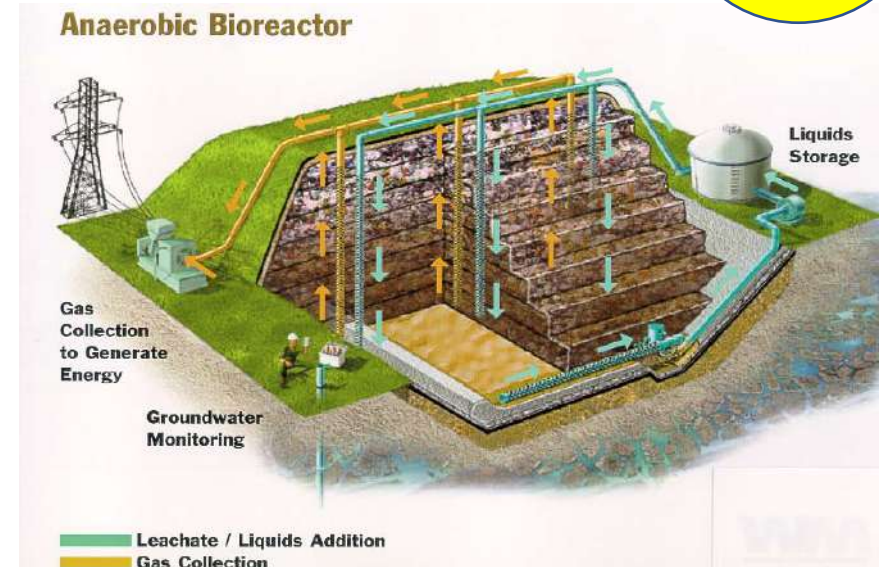
Function5: Waste Disposal

Waste disposal deals with the safe containment of the untreated municipal solid waste, rejected materials coming from the composting facilities, material recovery facilities (MRF) and incineration facilities etc. Rejected or residual materials are those which cannot be recycled.

B



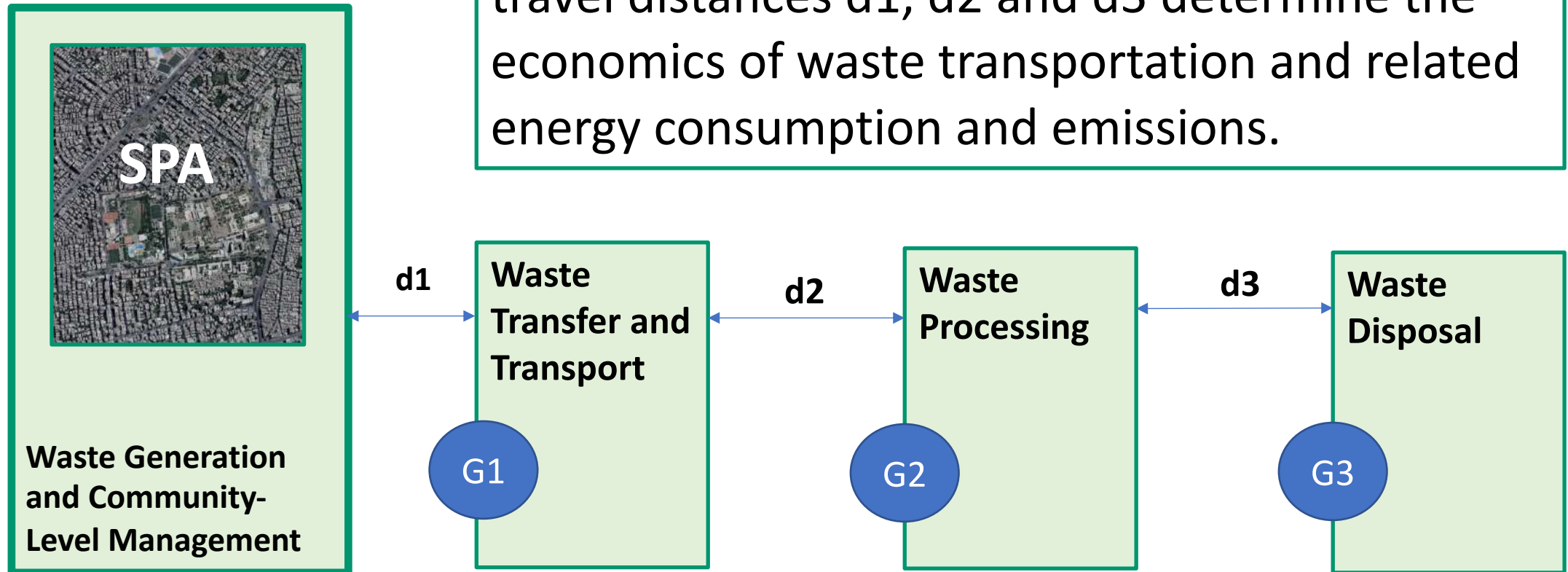
Source: Seoul National University; Design, operation and management of solid waste landfills; Laboratory of waste management and resource recirculation



Source: Don Davies Stantec Consulting Ltd.; 2010; Sustainable landfill biocell

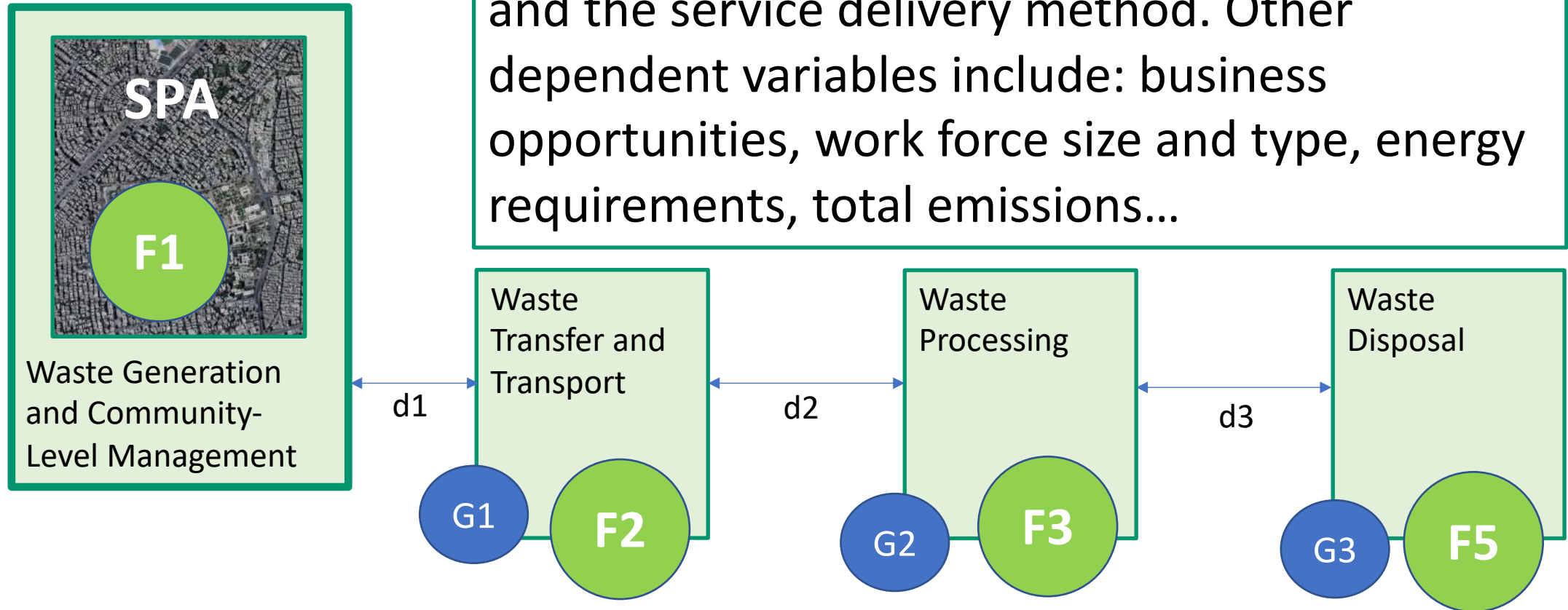
Service Provision Planning (SPP): Gates

The SPA specifies three Gates (Gs). The Gate concept is essential for contractual reasons. The travel distances $d1$, $d2$ and $d3$ determine the economics of waste transportation and related energy consumption and emissions.

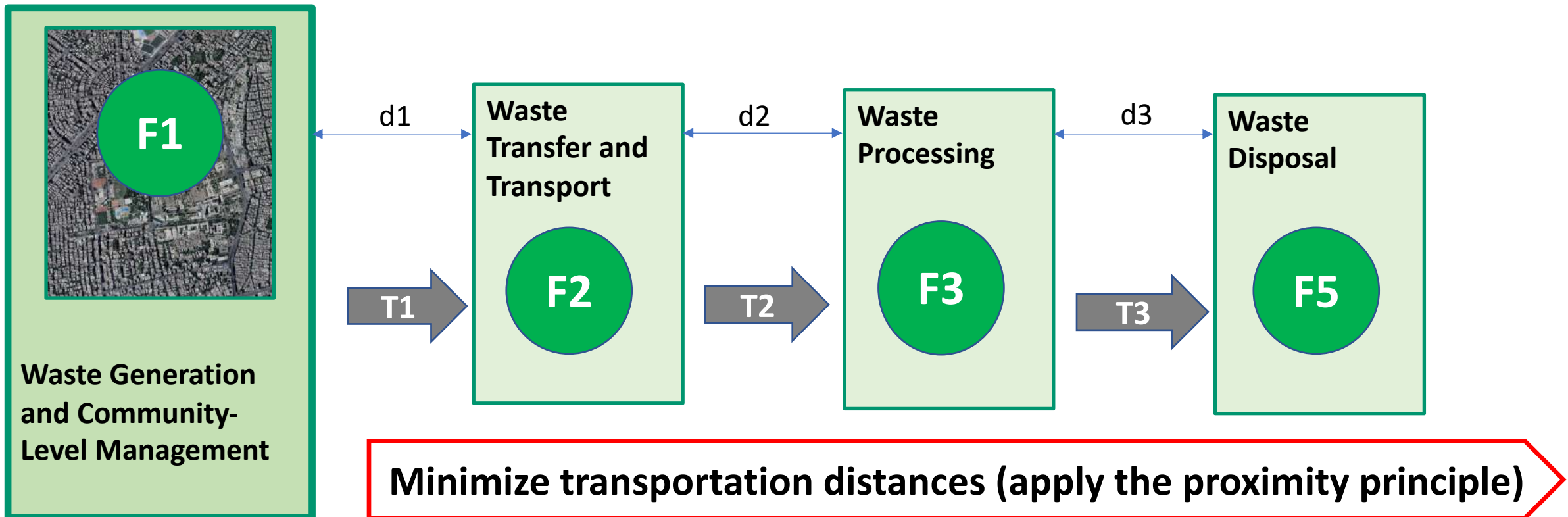
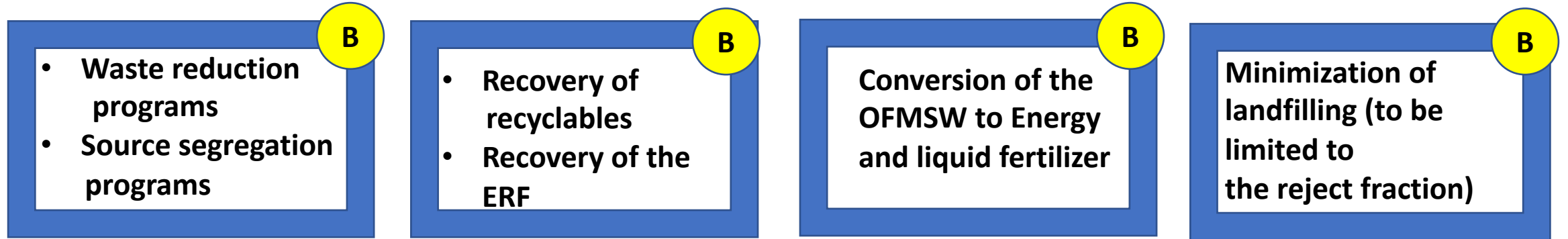


Service Provision Planning (SPP): Technology Combination

There are a wide range of technology options. The selection of any technology combination will influence the design of the infrastructure and the service delivery method. Other dependent variables include: business opportunities, work force size and type, energy requirements, total emissions...

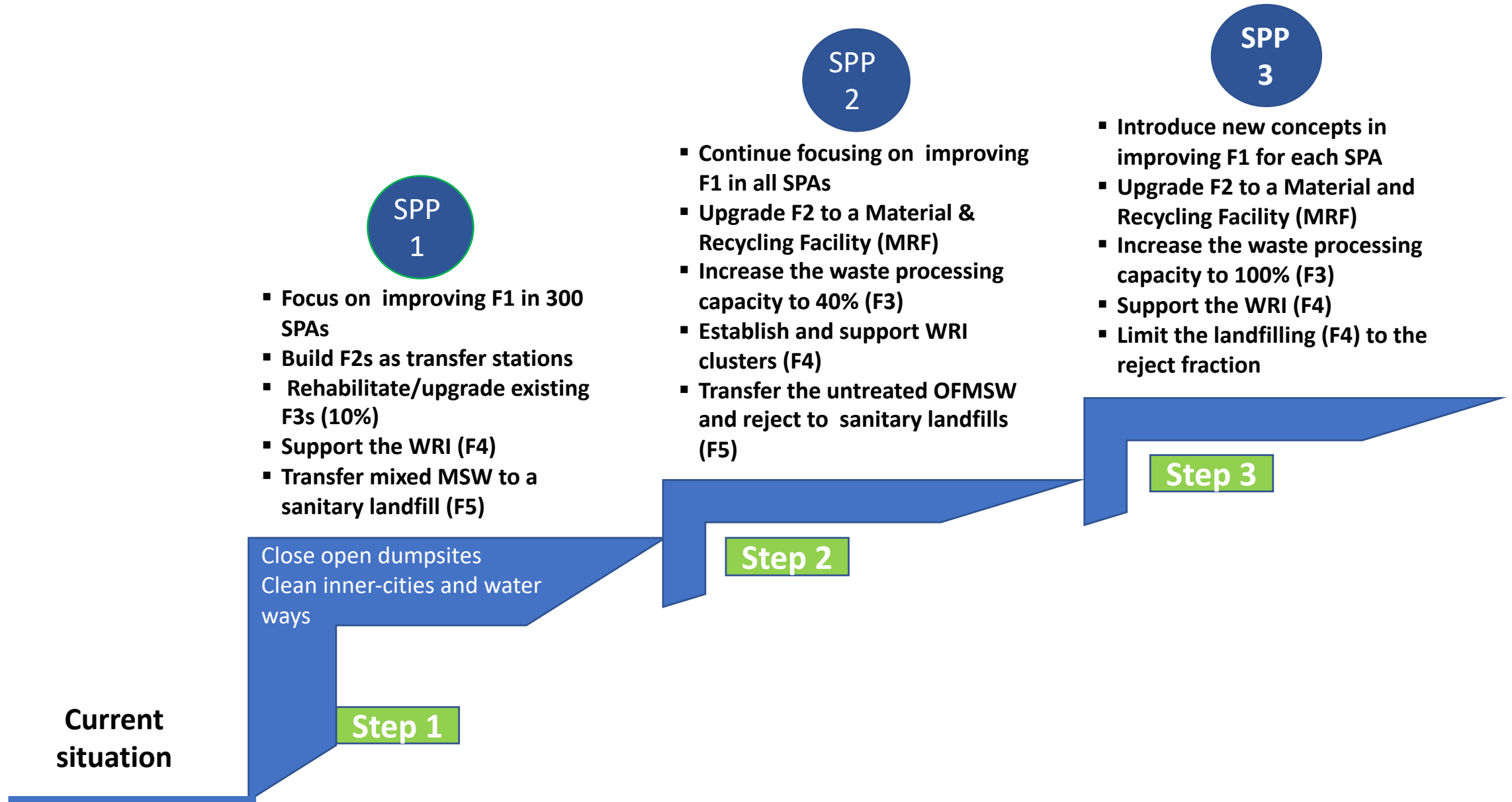


Service Provision Planning (SSP) – Circular Economy Perspective



Business Opportunities on a Timeline: The Resource Recovery Ladder (RRL) Method

Resources Recovery Ladder (RRL)



Resources Recovery Ladder (RRL)

- Initiate the following interventions:
- Provide technical and financial support to the informal sector
 - Introduce measures to lower waste generation rate
 - Introduce separation at-source

Engage
Community

SPP
1

- Focus on improving F1 in 300 SPAs
- Build F2s as transfer stations
- Rehabilitate/upgrade existing F3s (10%)
- Support the WRI (F4)
- Transfer mixed MSW to a sanitary landfill (F5)

Current
situation

Step 1

SPP
2

- Continue focusing on improving F1 in all SPAs
- Upgrade F2 to a Material & Recycling Facility (MRF)
- Increase the waste processing capacity to 40% (F3)
- Establish and support WRI clusters (F4)
- Transfer the untreated OFMSW and reject to sanitary landfills (F5)

Step 2

SPP
3

- Introduce new concepts in improving F1 for each SPA
- Upgrade F2 to a Material and Recycling Facility (MRF)
- Increase the waste processing capacity to 100% (F3)
- Support the WRI (F4)
- Limit the landfilling (F4) to the reject fraction

Step 3

Improve energy efficiency and minimize emissions

Resources Recovery Ladder (RRL)

Initiate the following interventions:

- Support SMEs/entrepreneurs in the waste recycling sector
- Initiate extended producer responsibility

Engage Community

SPP 1

- Focus on improving F1 in 300 SPAs
- Build F2s as transfer stations
- Rehabilitate/upgrade existing F3s (10%)
- Support the WRI (F4)
- Transfer mixed MSW to a sanitary landfill (F5)

SPP 2

- Continue focusing on improving F1 in all SPAs
- Upgrade F2 to a Material & Recycling Facility (MRF)
- Increase the waste processing capacity to 40% (F3)
- Establish and support WRI clusters (F4)
- Transfer the untreated OFMSW and reject to sanitary landfills (F5)

SPP 3

- Introduce new concepts in improving F1 for each SPA
- Upgrade F2 to a Material and Recycling Facility (MRF)
- Increase the waste processing capacity to 100% (F3)
- Support the WRI (F4)
- Limit the landfilling (F4) to the reject fraction

Current situation

Step 1

Step 2

Step 3

Improve energy efficiency and minimize emissions

Resources Recovery Ladder (RRL)

Initiate the following interventions:

- Provide technical and financial support to the informal sector
- Introduce measures to lower waste generation rate
- Introduce separation at-source

Initiate the following interventions:

- Support SMEs/entrepreneurs in the waste recycling sector
- Initiate extended producer responsibility

Engage Community

SPP 2

SPP 3

- Close open dumpsites
- Clean inner-cities and water ways

- Focus on improving F1 in 300 SPAs
- Build F2s as transfer stations
- Rehabilitate/upgrade existing F3s (10%)
- Support the WRI (F4)
- Transfer mixed MSW to a sanitary landfill (F5)

- Continue focusing on improving F1 in all SPAs
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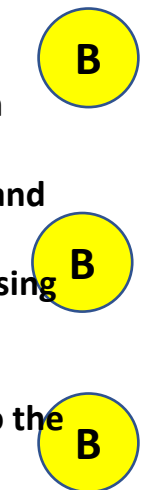
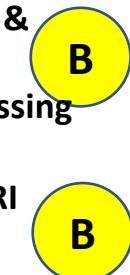
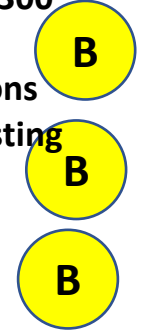
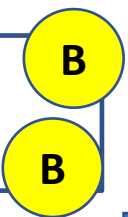
Current situation

Step 1

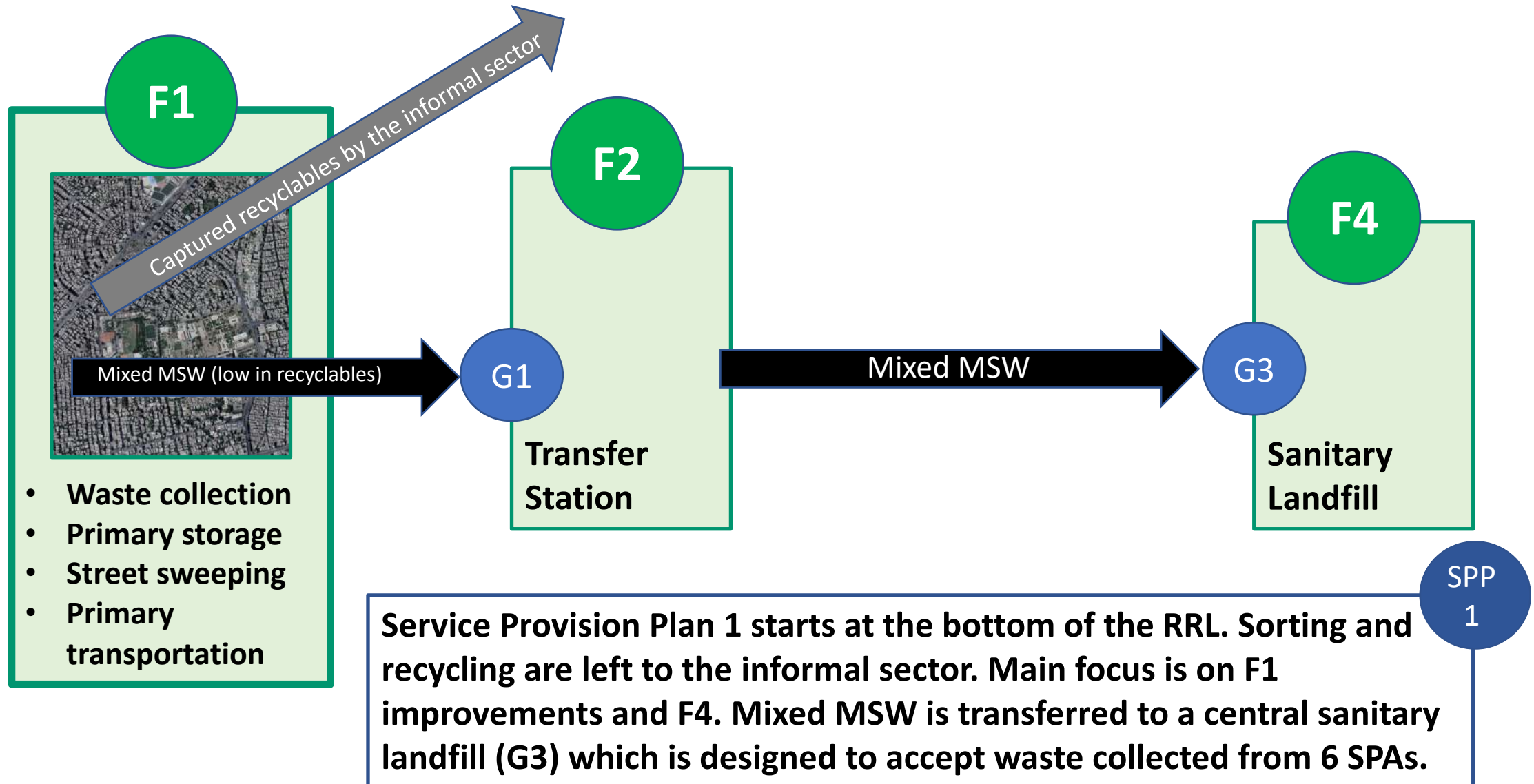
Step 2

Step 3

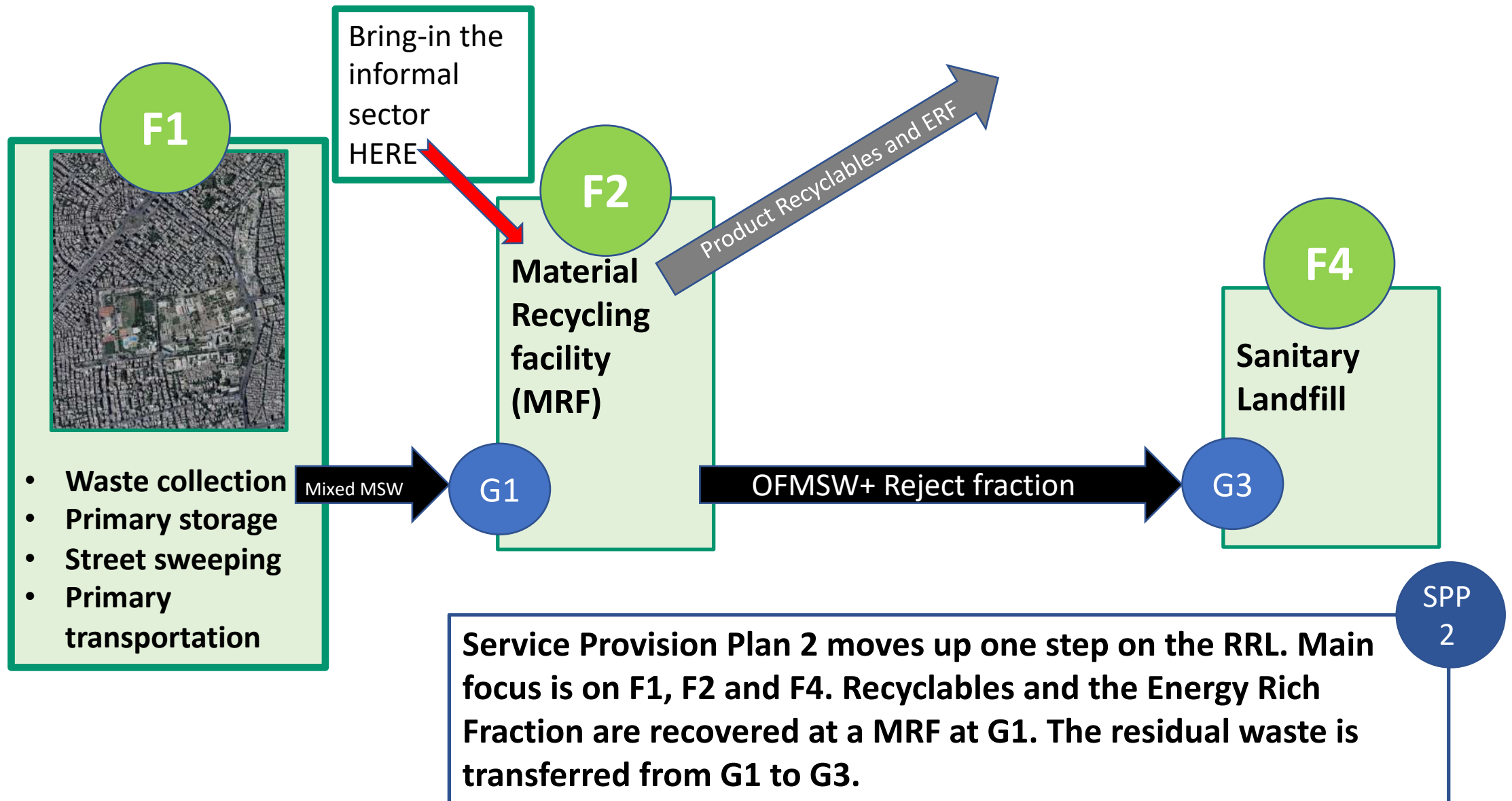
Improve energy efficiency and minimize emissions



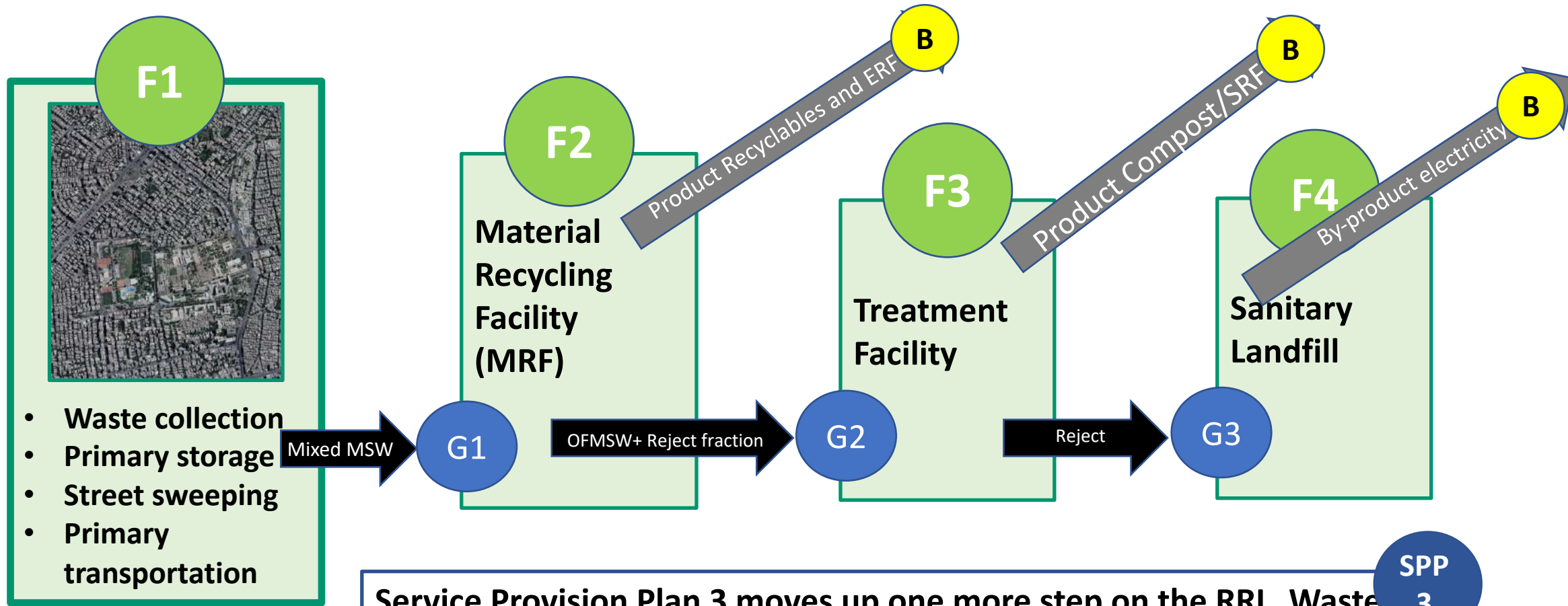
Integration of RRL into SPP design: Service Provision Plan 1



Integration of RRL into SPP design: Service Provision Plan 2



Integration of RRL into SPP design: Service Provision Plan 3



Service Provision Plan 3 moves up one more step on the RRL. Waste processing at G3 is established to utilize the OFMSW via different processes to recover the energy content and/or the biodegradable fraction in the form of compost (as per the standards). The major achievement is to limit landfilling at G3 to the reject fraction.

**Business Opportunities Contractual Context:
Project Delivery Methods (PDMs)**

Project Delivery Methods (PDMs)

F1

F2

**Community-Level
Management and Waste
Transfer & transport**

F3

F4

**Waste Processing &
Disposal**

**Infrastructure
Contracts**

- Development of community management infrastructure
- Development of transfer and transport infrastructure

- Development of waste processing infrastructure
- Development of waste disposal infrastructure

**Service
Contracts**

- Service contract for community level waste management
- Service contract for waste transfer and transport

- Service contract for waste processing
- Service contract for waste disposal

SPP-One contract approach

F1

F2

**Community-Level
Management and Waste
Transfer & transport**

F3

F4

**Waste Processing &
Disposal**

**Infrastructure
Contracts**

- Development of community management infrastructure
- Development of transfer and transport infrastructure

- Development of waste processing infrastructure
- Development of waste disposal infrastructure

**Service
Contracts**

- Service contract for community level waste management
- Service contract for waste transfer and transport

- Service contract for waste processing
- Service contract for waste disposal

SPP-Two Contracts Approach (vertical)

F1

F2

**Community-Level
Management and Waste
Transfer & transport**

F3

F4

**Waste Processing &
Disposal**

**Infrastructure
Contracts**

- Development of community management infrastructure
- Development of transfer and transport infrastructure

- Development of waste processing infrastructure
- Development of waste disposal infrastructure

**Service
Contracts**

- Service contract for community level waste management
- Service contract for waste transfer and transport

- Service contract for waste processing
- Service contract for waste disposal

SPP-Two Contracts Approach (horizontal)

F1

F2

**Community-Level
Management and Waste
Transfer & transport**

F3

F4

**Waste Processing &
Disposal**

**Infrastructure
Contracts**

- Development of community management infrastructure
- Development of transfer and transport infrastructure

- Development of waste processing infrastructure
- Development of waste disposal infrastructure

**Service
Contracts**

- Service contract for community level waste management
- Service contract for waste transfer and transport

- Service contract for waste processing
- Service contract for waste disposal

Concluding Remarks

- Integrated view of geography, streams, services and business opportunities offer enormous markets
- Linking the concept of public services to business value chains is a key to unlocking such markets
- This requires a paradigm shift in the mindset of the planners and decision makers

Or garbage will remain garbage