

# Towards a National Program for Capacity Building in the Waste Management Sector

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# Purpose Statement

The purpose of this work is to develop a capacity building approach in the waste management sector:

- 10 core modules are proposed to cover the main functions as conceptualized in the MSW sector reform paper as prepared by A Gaber in September 2017.
- 5 modules are proposed to cover the management of other types of wastes.
- 10 modules are proposed to cover technical management aspects.
- 5 modules are proposed to cover basic soft skills.

A guide for planning of capacity building programs in the Waste Recycling Industry (WRI) is covered in Annex A.

إعادة هيكلة وتطوير قطاع المخلفات الصلبة بمصر

الجزء الأول: مناقشة المسائل الأساسية والأهداف

أحمد جابر

٢١ سبتمبر ٢٠١٧

V15-1

إعادة هيكلة وتطوير قطاع المخلفات الصلبة بمصر

الجزء الثاني: المفاهيم الأساسية لتطوير البنية الأساسية لقطاع المخلفات الصلبة البلدية

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V15-2

إعادة هيكلة وتطوير قطاع المخلفات الصلبة بمصر

الجزء الثالث: اعتبارات تنفيذ مشروعات البنية الأساسية لقطاع المخلفات الصلبة البلدية

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V15-3

# The Four Planning Concepts, A Gaber 2017

Concepts		Brief Description
1	Service Provision Area (SPA)	A defined area in which all types of solid waste are generated, stored, and collected for transfer outside the area boundaries
2	Service Provision Plan (SPP)	A planning methodology to define the supply chain and value chain components for (1) <b>waste community level collection &amp; management</b> , (2) waste transfer & transport, (3) waste processing and (4) waste disposal.
3	Resource Recovery Ladder (RRL)	A planning concept which allows for gradual improvement in resource recovery to maximize material and energy recovery from the collected waste.
4	Waste Management Projects Breakdown Structure (WBS)	A planning methodology for clustering solid waste projects during the execution phase and operation phase.

# Presentation Outline

Concept 1: Service Provision Area (SPA)

Concept 2: Service Provision Plan (SPP)

Concept 3: Resources Recovery Ladder (RRL)

Concept 4: Waste Management Breakdown Structure WBS

# Presentation Outline

- Concept 1: Service Provision Area (SPA)
- Concept 2: Service Provision Plan (SPP)
- Concept 3: Resources
- Concept 4: Waste Management Structure WBS

Module 1: Planning

Module 1 shall cover all MSW planning fundamentals

# Concept 1: Service Provision Area (SPA)

# Concept 1: Service Provision Area (SPA)

**Population in each SPA is around 300,000**

**Each SPA has the following main characteristics:**

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

**On the operational level, each SPA is subdivided into a number of "Zones". This is required for contractual and control reasons.**

"شركة السبعين" للجمع والنقل  
تتعامل مع حوالي ٢٠ ألف وحدة  
سكنية، تولد حوالي ٧٠ طن/اليوم  
(بافتراض معدل التولد ٧،  
كجم/فرد/يوم)

# Concept 1: Service Provision Area (SPA)

Approximate Mixed MSW Generation: 200 ton/day

Basic Data	Existing MSW Management System	Other Wastes	Financial
<ul style="list-style-type: none"><li>• Location</li><li>• Area</li><li>• Population projections</li><li>• Roads and transportation</li><li>• Waste sources <b>(see next slide)</b></li></ul>	<ul style="list-style-type: none"><li>• On-site storage</li><li>• Collection system</li><li>• Transportation system</li><li>• Transfer stations</li><li>• Treatment facilities</li><li>• Temporary disposal sites</li><li>• Sanitary landfill site</li><li>• Existing accumulations</li></ul>	<ul style="list-style-type: none"><li>• Medical wastes</li><li>• Industrial non-hazardous waste</li><li>• Green waste</li><li>• Construction/demolition waste</li><li>• Hazardous waste</li><li>• Electronic waste</li></ul>	<p>Cost of service:</p> <ul style="list-style-type: none"><li>• Formal sector</li><li>• Informal sector</li></ul>

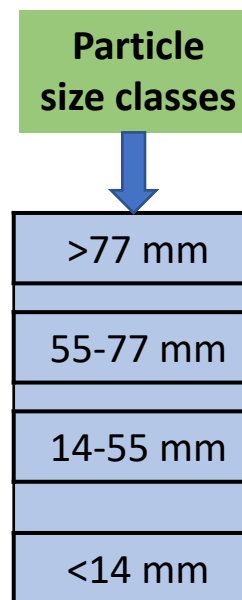


# Classification of Waste Generated from a Typical SPA

No.	Waste Source	Typical facilities and activities generating wastes in SPAs
1	<b>Residential</b>	Includes single and multi-story houses and high density apartments. Type of solid waste includes: food waste, rubbish, ashes and special wastes.
2	<b>Commercial</b>	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	<b>Institutional</b>	Schools, hospitals, police stations, governmental centers etc. Waste similar to residential and commercial is produced in these establishments.
4	<b>Municipal</b>	The term Municipal Solid Waste (MSW) is used for mixed or source-separated waste generated from residential, commercial and institutional facilities
5	<b>Industrial</b>	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	<b>Open Areas</b>	Includes streets, vacant lots, play grounds, beaches, recreational areas etc. Type of waste includes special waste and rubbish.
7	<b>Inner-city utilities</b>	It includes water and wastewater pumping stations and Scalping plants. Waste is principally composed of screenings, residual sludge and other minor components.
8	<b>Green areas</b>	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	← <b>1. Organics</b>	16. Clothes (Synthetic) 17. Clothes (Non-synthetic) 18. Non-clothing textiles
4. Untreated 5. Treated	← <b>2. Wood</b>	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	← <b>3. Paper</b>	22. Batteries/ Accumulators 23. Miscellaneous hazardous waste
9. PETE 10. HDPE 11. Low quality plastics 12. Other hard plastics	← <b>4. Plastics</b>	24. Composite /Complex packaging 25. Composite/ Complex Non-packaging
13. Clear Glass Container 14. Color Glass Container 15. Miscellaneous Non Packaging Glass	← <b>5. Glass</b>	26. waste of electrical and electronic equipment
		27. Soil, Stones and other inerts
		28. Household health care
		29. <10mm
		30. Liquid leftover and leachate
		← <b>6. Textiles</b>
		← <b>7. Metals</b>
		← <b>8. Hazardous</b>
		← <b>9. Composite</b>
		← <b>10. Mixed WEEE</b>
		← <b>11. Inert</b>
		← <b>12. HH Medical</b>
		← <b>13. Fine particles</b>
		← <b>14. Liquids</b>



## A. Chem. Composition

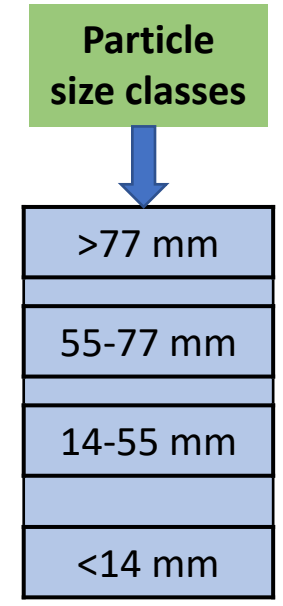
1. Carbon, 2. Nitrogen
3. Hydrogen, 4. Oxygen
5. Sulphur, 6. Chlorine
7. Phosphorous,
8. Heavy Metals
9. HHV, 10. TOC, 11. TIC
12. Water content, 13. Ash

**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.**

# MSW Categories and Characterization

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

**Module 2: MSW Characterization**  
**Module 2 will introduce the MSW characterization toolkit**



- A. Chem. Composition**
1. Carbon
  2. Nitrogen
  3. Hydrogen
  4. Oxygen
  5. Sulphur
  6. Chlorine
  7. Phosphorous
  8. Heavy Metals
  9. HHV
  10. TOC
  11. TIC
  12. Water content
  13. 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.

# 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

## **Concept 2: Service Provision Plan (SPP)**

# Concept 2: Service Provision Plan (SPP): Scope



**Waste Generation  
and Community-  
Level Management**

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.

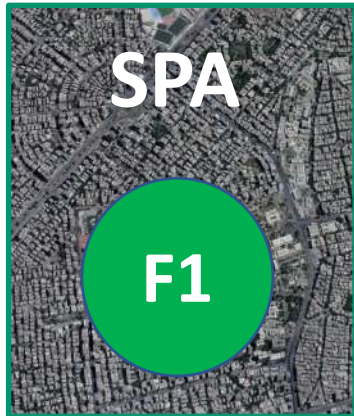
**Waste  
Transfer and  
Transport**

**Waste  
Processing**

**Waste  
Disposal**

# Service Provision Plan (SPP): The Four Functions

The Service Provision Plan divides all works and waste management related activities into four geographically separated FUNCTIONS (Fs). Each function specifies the technology applied and the associated management system.



**Waste Generation  
and Community-  
Level Management**

**Waste  
Transfer and  
Transport**

**F2**

**Waste  
Processing**

**F3**

**Waste  
Disposal**

**F4**

# Service Provision Plan (SPP): Functions

A Service Provision Plan divides all works and management related activities into four geographical separated FUNCTIONS (Fs). Each function is defined by the technology used and the management.

Module 3: waste generation and community level management



F1

Waste Generation and Community Level Management

Module 4: waste transfer and transport



F2

Transfer and Transport

Module 5: waste processing



F3

Processing

Module 6: waste disposal



F4

Disposal



# Service Provision Plan (SPP): Functions

## Module 3,4,5 and 6

Each module covers:

- Technology review
- Design basics
- Plant design aspects
- Utility management aspects
- Monitoring and evaluation
- EHS
- O&M
- Economics
- Case studies

Service Provision Plan divides all works and equipment related activities into four separated FUNCTIONS (Fs). Each function covers the technology applied and the management system.

Waste Processing

F3

Waste Disposal

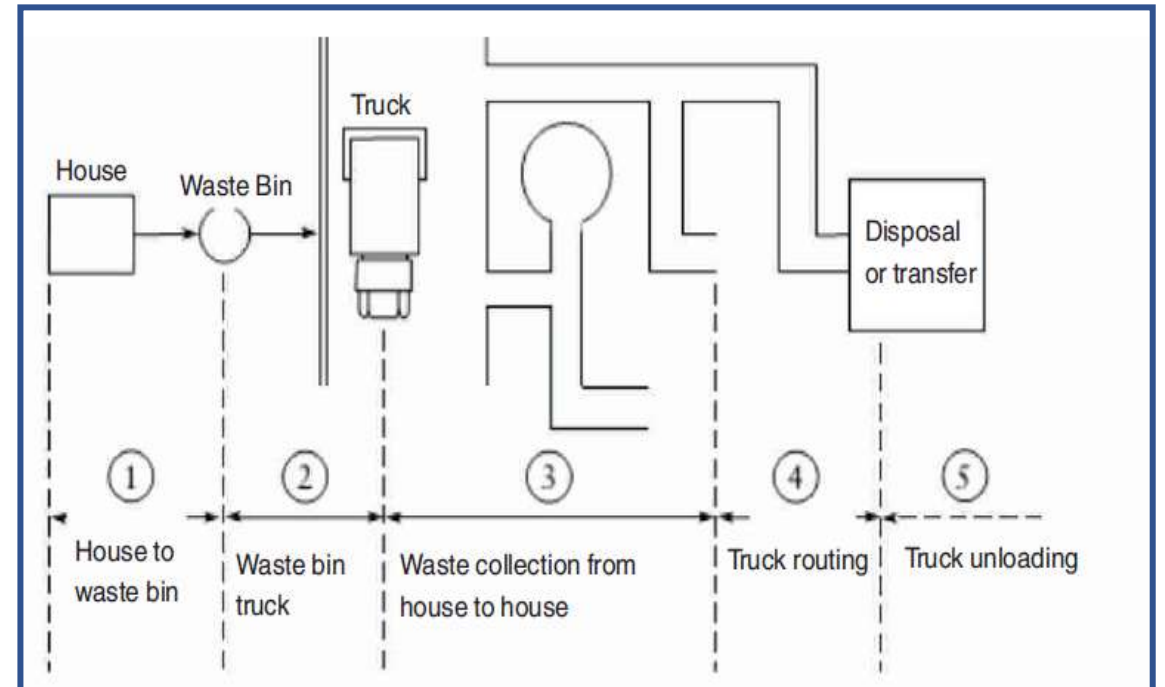
F4

Waste  
and  
Level

# 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

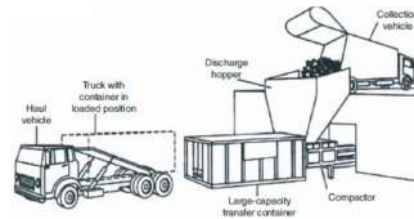


## Function2: Waste Transfer and Transport

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



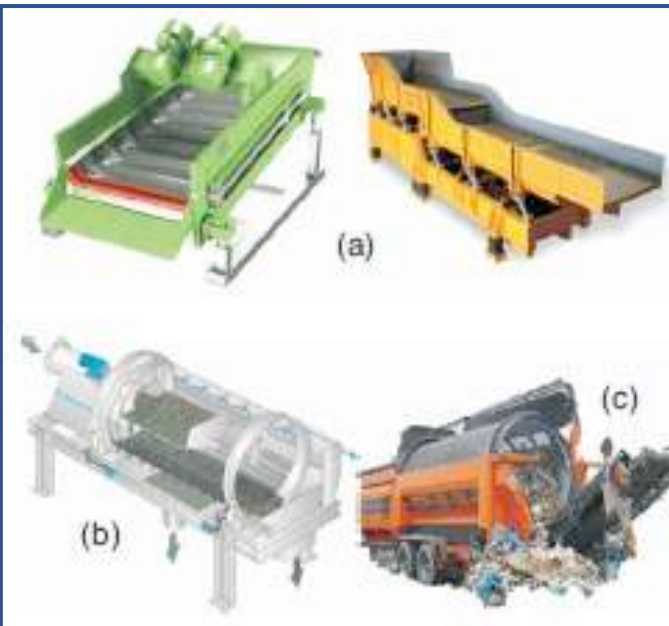
### Material Recycling Facilities: Dirty, Clean and Hybrid



# Function3: Waste Processing

## Waste Processing for Efficiency Improvement:

- Densification
- Mechanical Shredding
- Component Separation
- Moisture Reduction



(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



## Waste Processing for Energy Production:

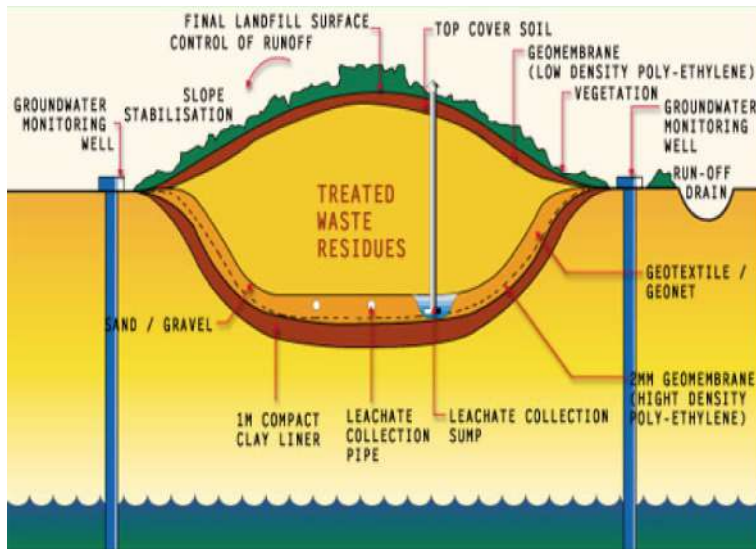
- Incineration
- Pyrolysis
- Bio-digestion





## Function4: 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.



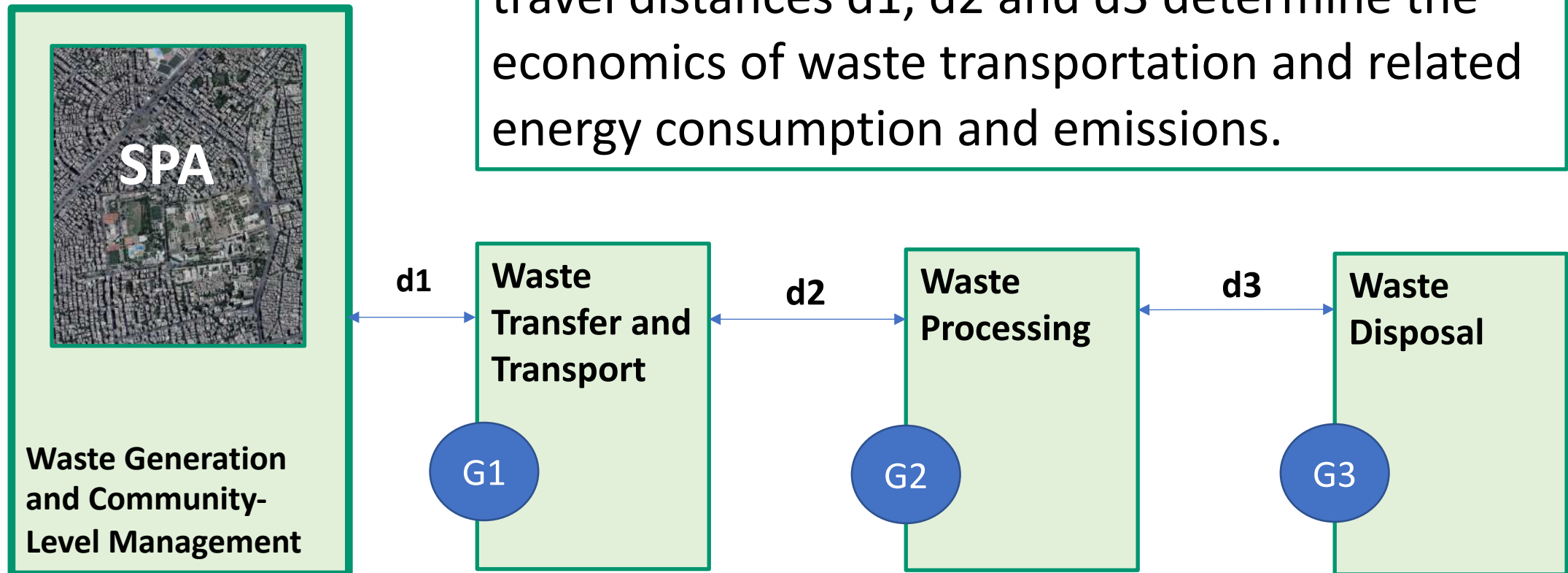
Source: Seoul National University; Design, operation and management of solid waste landfills; Laboratory of waste management and resource recirculation



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

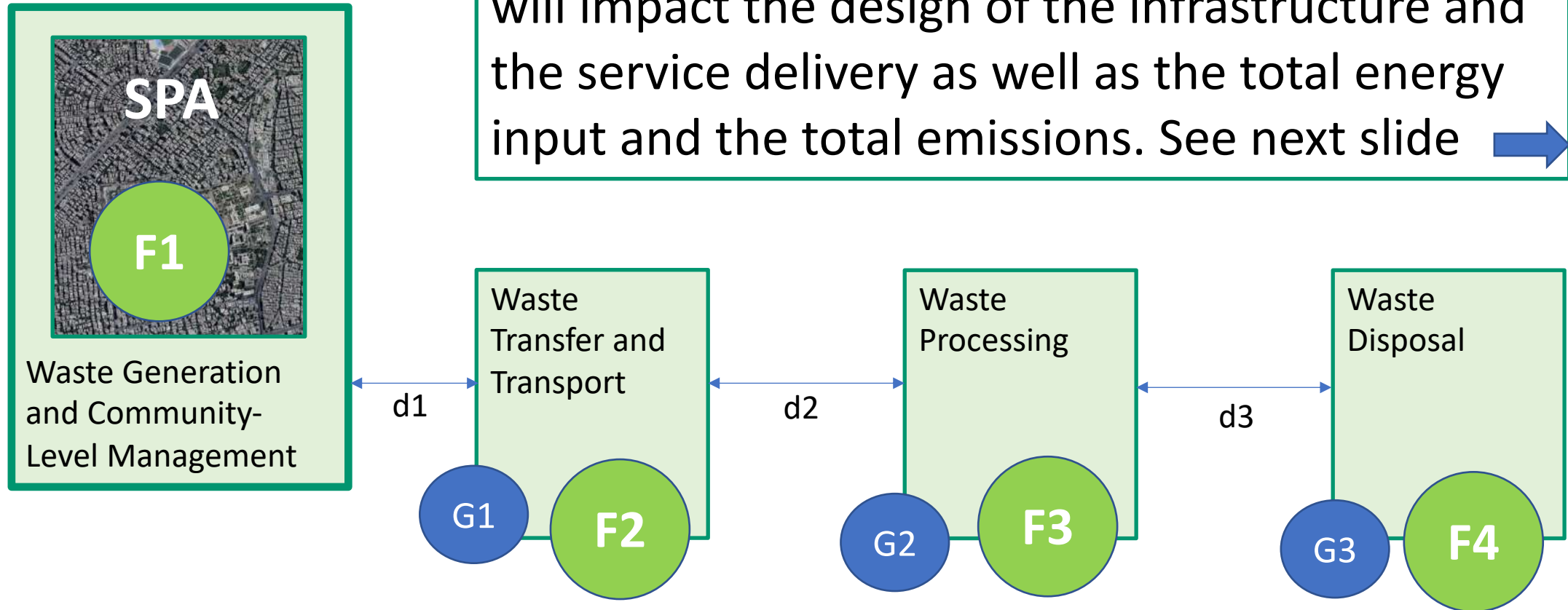
# Service Provision Plan (SPP): The Three Gates

The SPA specifies three Gates (Gs). The Gate concept is needed for contractual reasons. The travel distances  $d_1$ ,  $d_2$  and  $d_3$  determine the economics of waste transportation and related energy consumption and emissions.



# Service Provision Plan (SPP): Technology Combination

There are a wide range of technology options. The selection of the technology combination will impact the design of the infrastructure and the service delivery as well as the total energy input and the total emissions. See next slide →



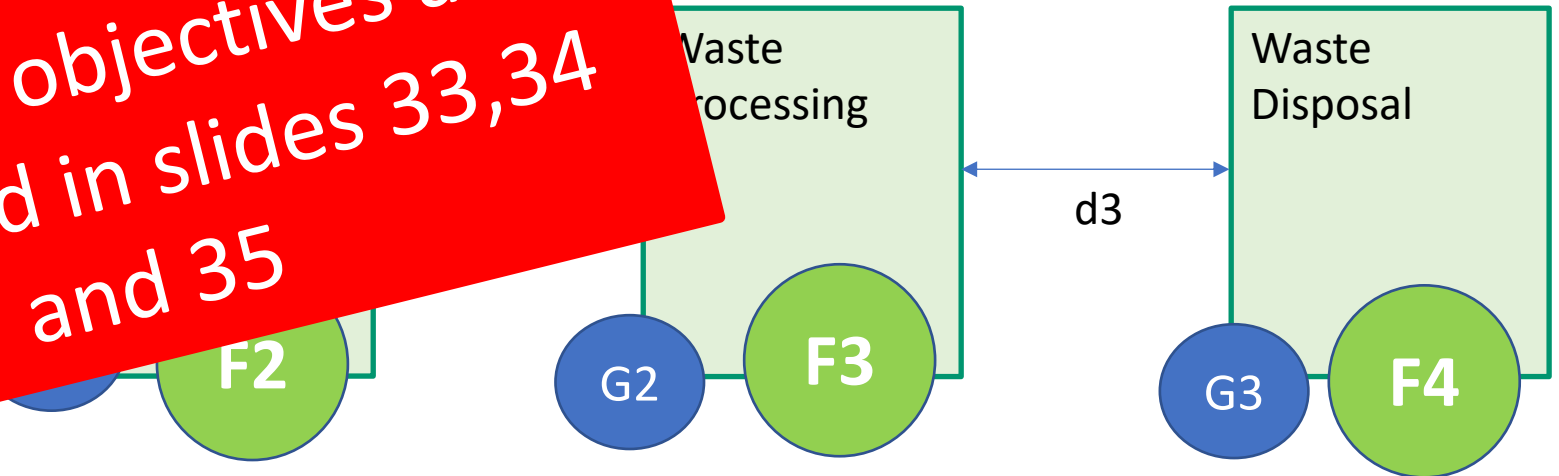
# Service Provision (SP): Technology Combination

Module 7: Design of integrated MSW management systems

Module 7 shall cover the synthesis of combinations of technologies to satisfy specific objectives as illustrated in slides 33,34 and 35

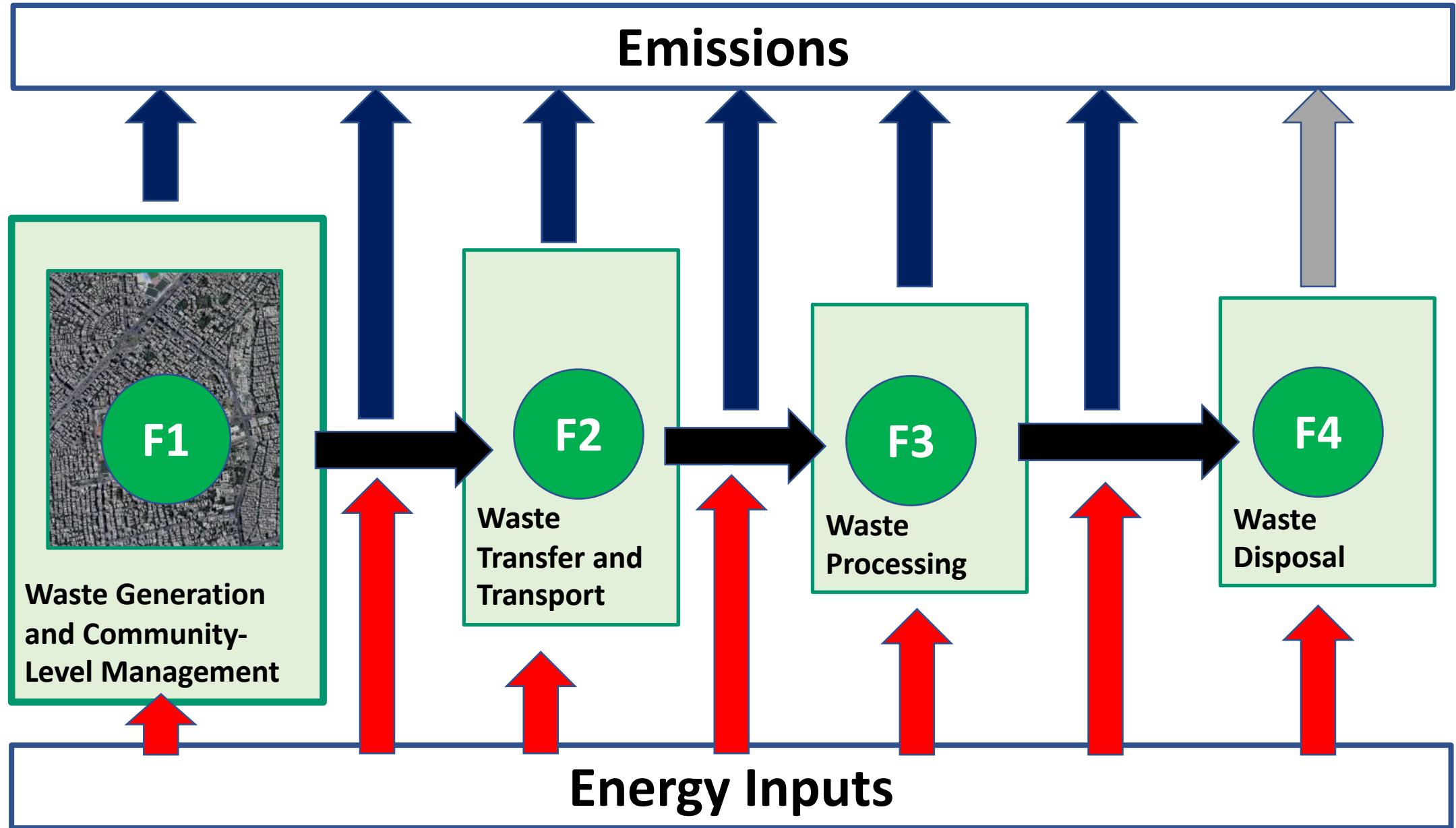
A wide range of technology options. The technology combination design of the infrastructure and energy as well as the total energy emissions. See next slide →

Waste and C  
Level M

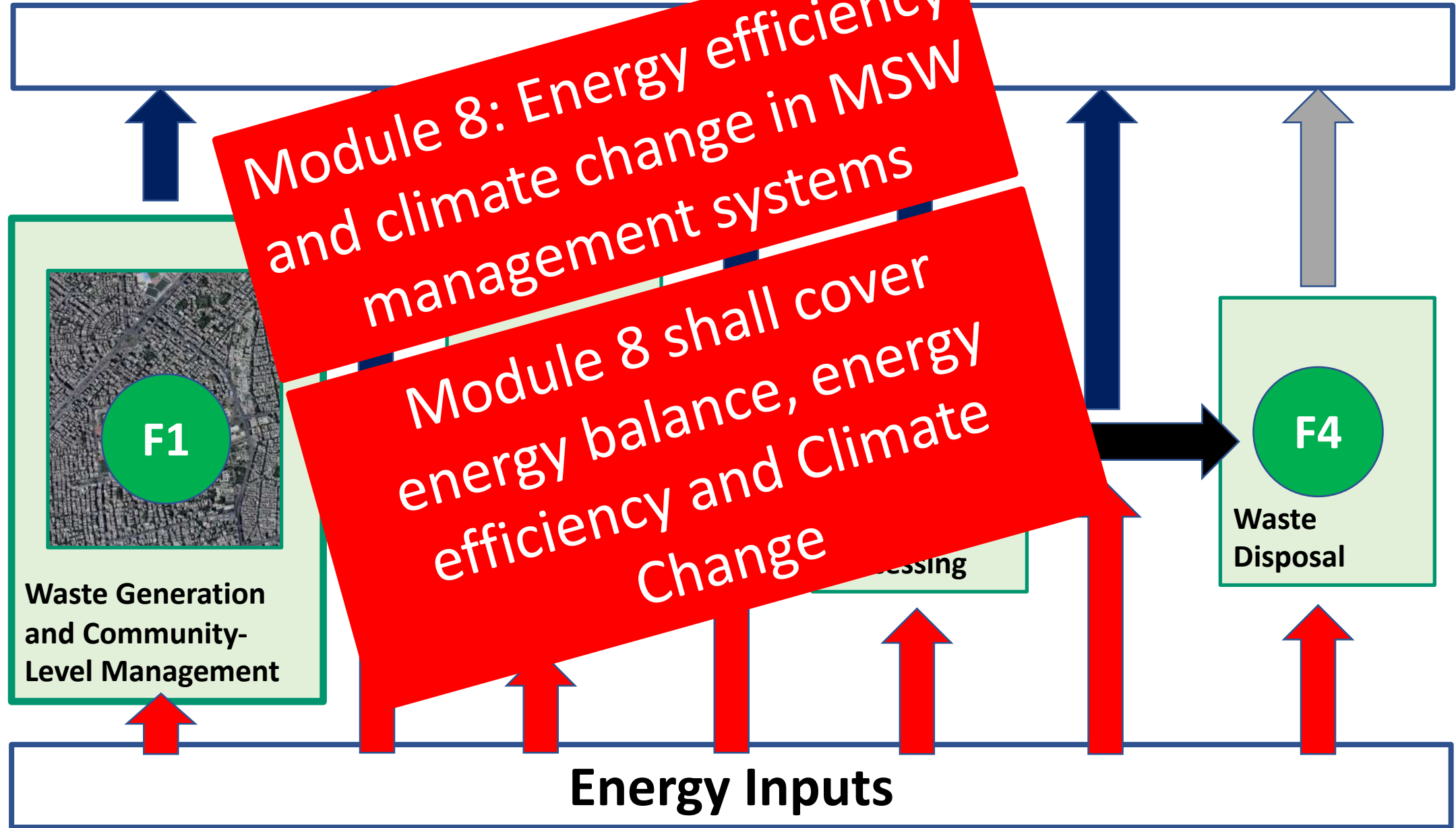




# Service Provision Plan (SPP): Energy Inputs and Emissions



# Service Provision Plan (SPP): Energy Inputs and Emissions



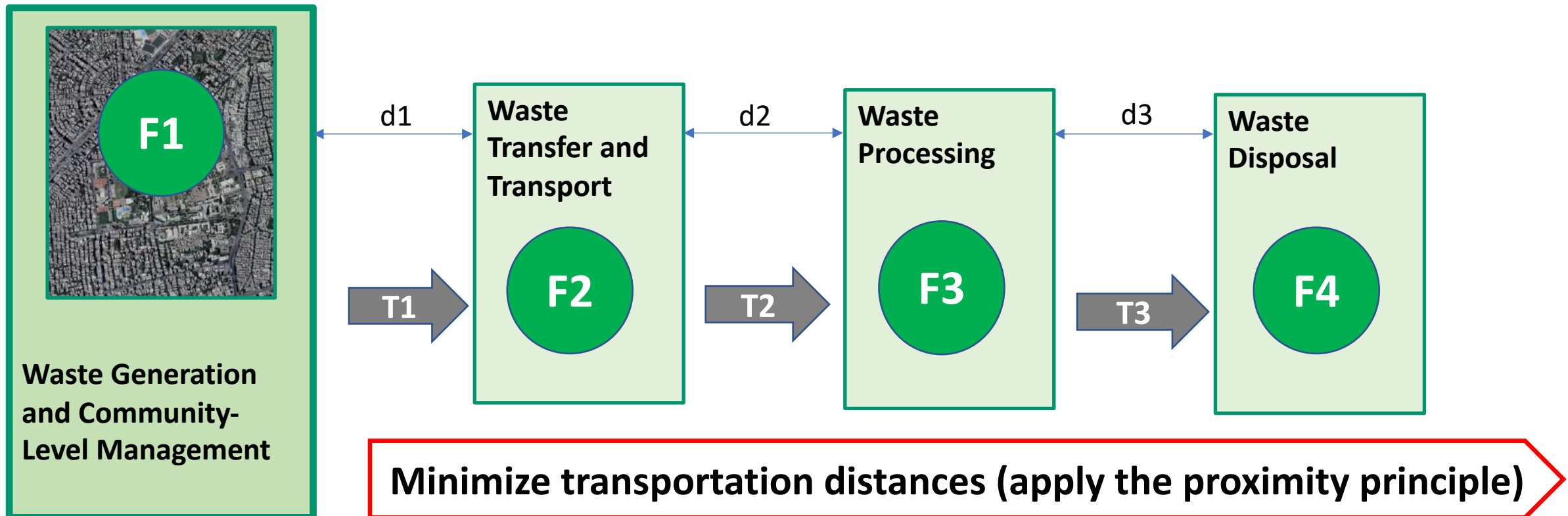
# Service Provision Plan (SSP) – CC focus

- Waste reduction program
- Source segregation program

- Recovery of recyclables
- Recovery of the ERF

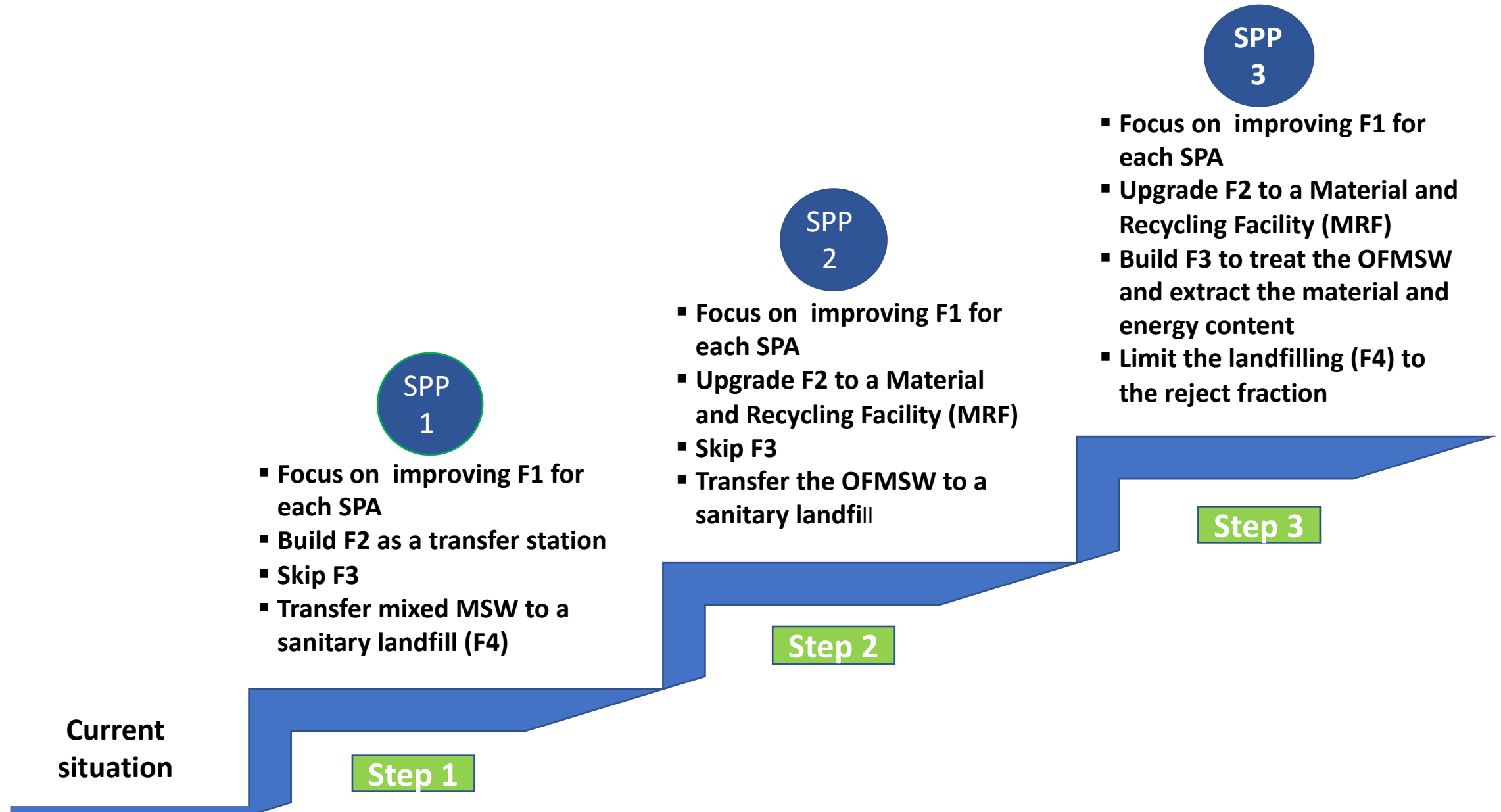
Conversion of the OFMSW to Energy and liquid fertilizer

Minimization of Landfilling (to be limited to the reject fraction)



## **Concept 3: Resource Recovery Ladder (RRL)**

# Resources Recovery Ladder (RRL)



# Resources Recovery Ladder (RRL)

Initiate the following interventions:

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

Engage Community

SPP 1

- Focus on improving F1 for each SPA
- Build F2 as a transfer station
- Skip F3
- Transfer mixed MSW to a sanitary landfill (F4)

SPP 2

- Focus on improving F1 for each SPA
- Upgrade F2 to a Material and recycling Facility (MRF)
- Skip F3
- Transfer the OFMSW to a sanitary landfill

SPP 3

- Focus on improving F1 for each SPA
- Upgrade F2 to a Material and recycling Facility (MRF)
- Build F3 to treat the OFMSW and extract the material and energy content
- 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:

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

Engage Community

SPP 1

- Focus on improving F1 for each SPA
- Build F2 as a transfer station
- Skip F3
- Transfer mixed MSW to a sanitary landfill (F4)

Step 1

Current situation

SPP 2

- Focus on improving F1 for each SPA
- Upgrade F2 to a Material and recycling Facility (MRF)
- Skip F3
- Transfer the OFMSW to a sanitary landfill

Step 2

SPP 3

- Focus on improving F1 for each SPA
- Upgrade F2 to a Material and recycling Facility (MRF)
- Build F3 to treat the OFMSW and extract the material and energy content
- Limit the landfilling (F4) to the reject fraction

Step 3

Improve energy efficiency and minimize emissions

# Resources Recovery Ladder (RRL)

**Module 9: Resource recovery**

**Module 9 shall cover the concept of resources recovery ladder (RRL) with special focus on recycling**

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

Engage Communities

SPP 3

Focus on improving F1 for SPA  
Transfer F2 to a Material and Facility (MRF)  
to treat the OFMSW  
at the material and  
content  
landfilling (F4) to  
action

SPP 1

- Focus on improving each SPA
- Build F2 as a transfer station
- Skip F3
- Transfer mixed MSW to sanitary landfill (F4)

Step 3

Step 2

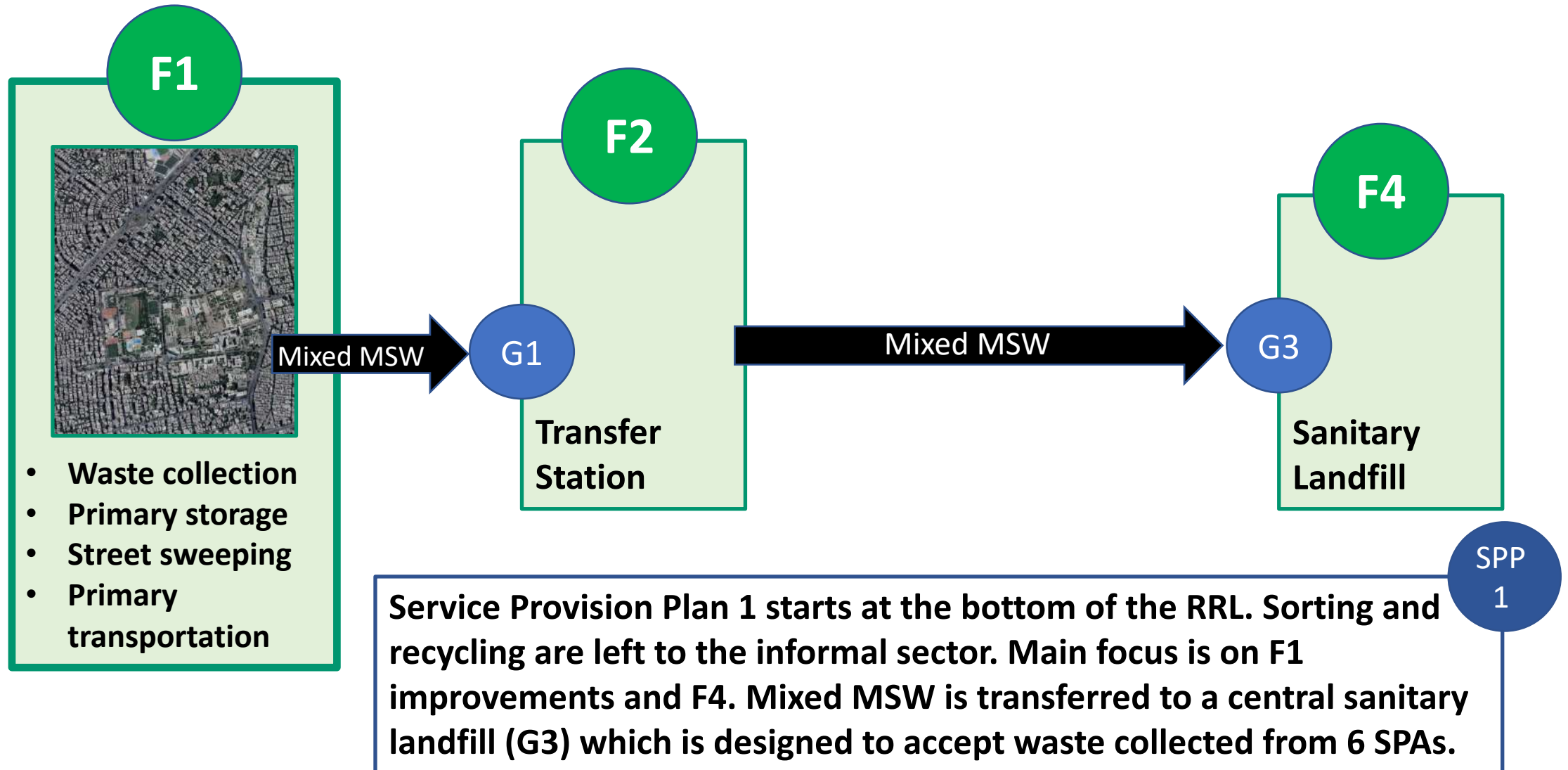
Improve energy efficiency and minimize emissions

Current situation

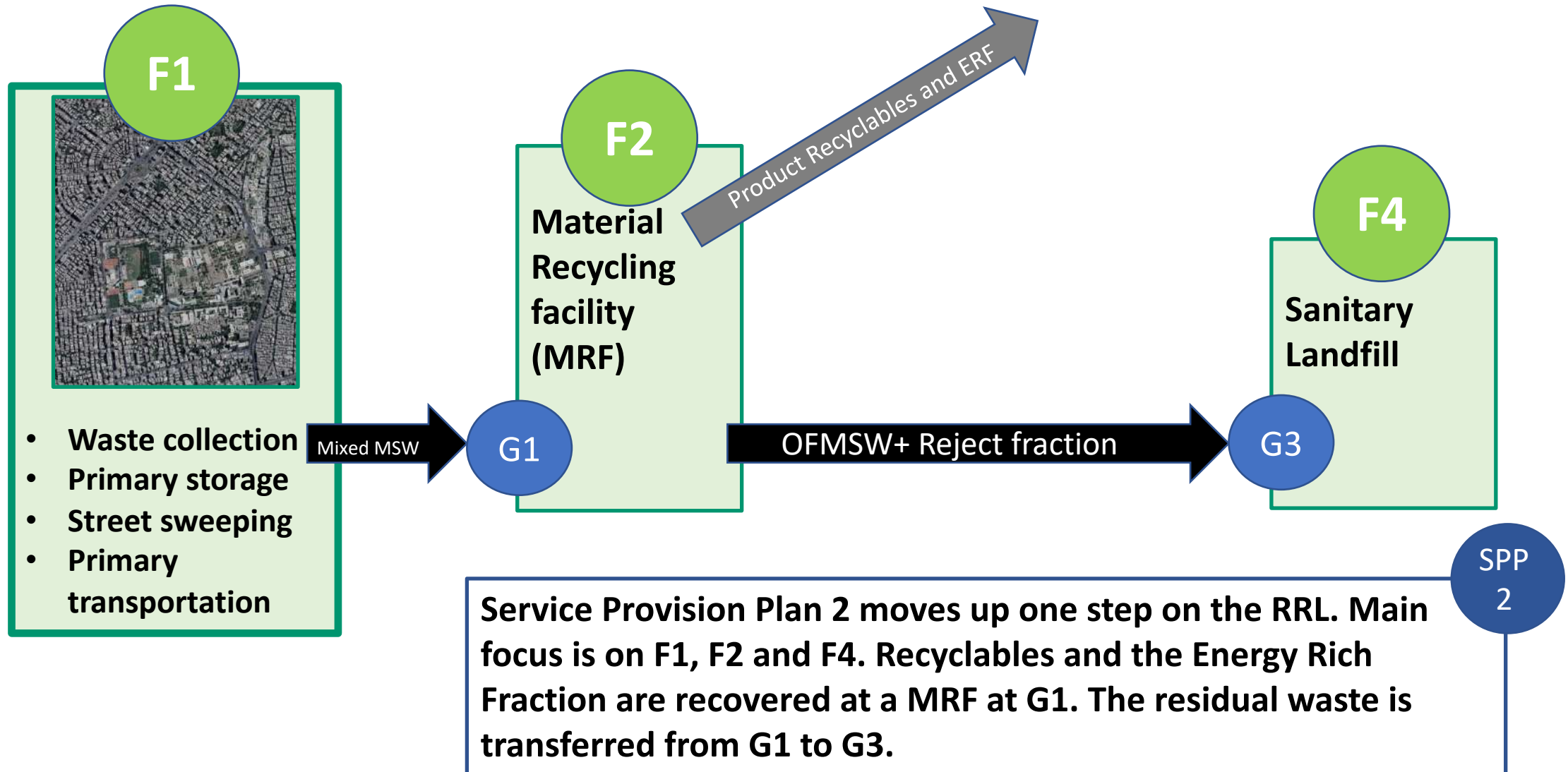
Step 1



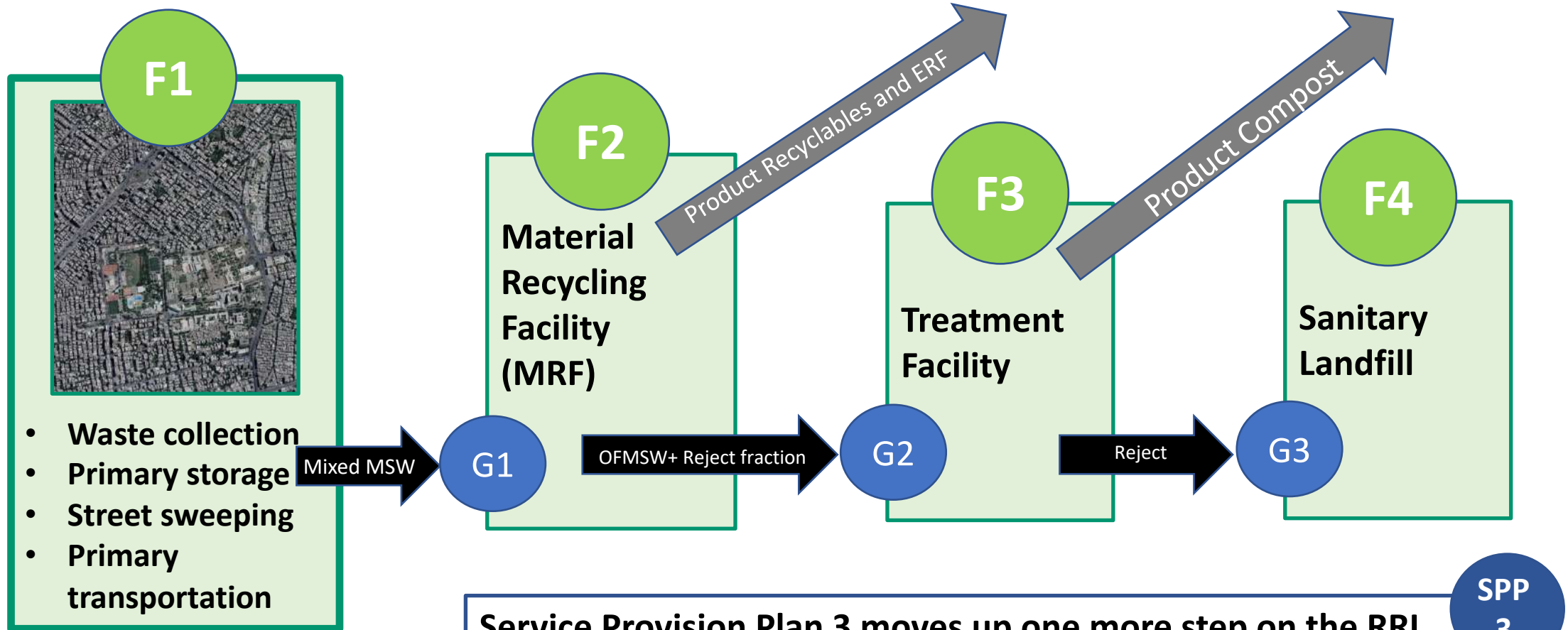
# Integration of RRL into SPP design: Service Provision Plan 1



# 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. The major achievement is to limit landfilling at G3 to the reject fraction.

SPP  
3

# Concept 4: Waste Management Projects

WBS

# Work Breakdown Structure (WBS)

**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

# Work Breakdown Structure (WBS)



# 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

## Other Waste Management Modules

Module number	Module title
11	Managing open dump sites
12	Health care waste management
13	Managing C/D waste
14	Managing e-waste
15	Managing industrial non-hazardous waste

# Technical Management Modules

Module number	Module title
16	Project management, focus on scope, quality, cost and time management
17	Project management, focus on construction supervision
18	Project management, focus on commissioning and start up
19	Utility management, focus on O&M
20	Asset management (all assets in F1,F2,F3 and F4)

## Technical Management Modules<sup>(cont.'d)</sup>

Module number	Module title
21	Human resources management
22	Financial management
23	Stakeholders management
24	Risk management
25	Environmental management

# Soft Skills Modules

Module number	Module title
26	Management 101
27	Leadership 101
28	Problem solving and decision making
29	Workforce planning
30	Basic communication skills

## Annex A: The Waste Recycling Industry (WRI)

Guide for planning of capacity building programs in the WRI

# Proposed 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

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

# Proposed Waste Recycling Industry Categorization (Cont'd)

Category	Code	Industry	Feedstocks	Products
Category 1: Collection and Transportation of All Types of Waste	R1.1	Collection and Transportation of MSW	Mixed and/or source-separated MSW	Collected MSW delivered to transfer stations, MRF facilities, treatment facilities or disposal sites
	R1.2	Transportation of C/D Waste	Construction/demolition waste material	Mixed and sorted C/D waste
	R1.3	Collection and Transportation of Industrial Wastes	All types of industrial wastes	Collected industrial wastes delivered to recycling facilities or disposal sites
	R1.4	Collection and Transportation of Agricultural Waste	All types of agricultural waste	Collected agriculture waste delivered to intermediate storage, processing facilities or W2E facilities



# Proposed Waste Recycling Industry Categorization (Cont'd)

Category	Code	Industry	Feedstocks	Products
Category 2: Sorting and Densification of Types of Waste	R2.1	MSW Transfer Stations and MRF Facilities	Mixed and/or sorted MSW	Baled recyclables Baled energy rich fraction OFMSW
	R2.2	Industrial Waste Transfer Stations	All types of industrial wastes	Sorted industrial waste
	R2.3	Agriculture Waste Collection Sites	All types of agriculture wastes	Agriculture waste in the form of: Bales, Pellets, Cubes, Briquettes, Torrefied agriculture waste.

# Proposed Waste Recycling Industry Categorization (Cont'd)

Category	Code	Industry	Feedstocks	Products
Category 3: MSW Treatment and Disposal	R3.1	Mechanical/Biological Treatment (MBT)	Mixed and/or pre-sorted OFMSW	<ul style="list-style-type: none"> <li>• Compost</li> <li>• Power</li> <li>• RDF</li> <li>• Recyclables</li> </ul>
	R3.2	Alternative Fuels-MSW	Sorted fractions from MSW	RDF SRF
	R3.3	Sanitary Landfills	Mixed MSW, sorted MSW, reject fraction of MSW	Electricity (Bioreactor LF: LFG to electricity) No product from reject fraction landfilling

# Proposed Waste Recycling Industry Categorization (Cont'd)

Category	Code	Industry	Feedstocks	Products
Category 4: Waste Glass Recycling	R4.1	Glass Containers (closed-loop glass recycling)	Waste soda lime- silicate glass (cullet)	Finished glass containers
	R4.2	Glass Products (open-loop glass recycling)	Scrap glass	Glass products, examples include: <ul style="list-style-type: none"> <li>• Ballontini (high reflective glass spheres)</li> <li>• Glass wool</li> <li>• Foamed glass</li> <li>• Ingredient in ceramic industry</li> <li>• Ingredient in abrasives</li> <li>• Ingredient in bituminous highway pavement</li> <li>• Aggregate mix in special concrete</li> </ul>

# Proposed Waste Recycling Industry Categorization (Cont'd)

Category	Code		Industry	Feedstocks	Products
Category 5: Metals Scrap Recycling	R5.1 Non-Ferrous Metals	R5.1.1	Nonferrous Secondary Smelting and Refining Mills	Nonferrous scrap	Recycled and alloyed nonferrous metals in the form of billets, ingots and other shapes
		R5.1.2	Nonferrous Product Producers	Nonferrous scrap	Nonferrous products produced through extrusion, rolling or drawing processes
		R5.1.3	Nonferrous Foundries	Nonferrous scrap	Casted nonferrous metals
	R5.2 Ferrous Metals	R5.2.1	Iron and Steel Mills	Ferrous scrap and/or raw materials	Iron and steel slabs, billets, bars, plates
		R5.2.2	Iron and Steel Foundries		Cast iron or steel products

# Proposed Waste Recycling Industry Categorization (Cont'd)

Category	Code	Industry	Feedstocks	Products
Category 6: Paper Recycling	R6.1	Paper, Paperboard and Deinked Market Pulp Mills	Recovered paper or market pulp and/or de-ink recovered paper and sell pulp	Paper and paperboard products
	R6.2	Paper-Based Product Manufacturers	Recovered paper or paper – board	Cellulose-based products

# Proposed Waste Recycling Industry Categorization (Cont'd)

Category	Code	Industry	Feedstocks	Products
Category 7: Textile Waste Recycling	R7.1	Mechanical Processing of Textile Waste	Textile waste	Material reuse: <ul style="list-style-type: none"> <li>• Wipes</li> <li>• Rags</li> <li>• Insulation material</li> <li>• Wallets</li> <li>• Bags</li> </ul>
	R7.2	Chemical Processing of Textile Waste	Textile waste	<ul style="list-style-type: none"> <li>• Cellulosic fibers</li> <li>• Synthetic fibers</li> <li>• Fiber blends</li> </ul>

# Proposed Waste Recycling Industry Categorization (Cont'd)

Category	Code	Industry	Feedstocks	Products
Category 8: Plastics Recycling	R8.1	Plastics Reclaiming Industry	Recovered Plastics	Plastic products (e.g plastic lumber) or raw material ready for remanufacturing
	R8.2	Plastics Conversion Industry	Recycled plastic clean flake or pellets	Intermediate or end plastic products

# Proposed Waste Recycling Industry Categorization (Cont'd)

Category	Code	Industry	feedstocks	Products
Category 9: Rubber Waste Recycling	R9.1	Pyrolysis of waste tires	Waste tires	<ul style="list-style-type: none"> <li>• Pyrolytic oil (to be fractionated to Tire-derived fuel and Heavy fuel oil)</li> <li>• Carbon black</li> </ul>
	R9.2	Shredded Tire Production and processing	Shredded tire	<ul style="list-style-type: none"> <li>• Tire alternative fuel (cement industry)</li> <li>• Interior flooring (playground surfaces, parking lots)</li> </ul>
	R9.3	Crumb Rubber Production and Processing	Crumb rubber	<ul style="list-style-type: none"> <li>• Rubber modified asphalt</li> <li>• Tire-reinforced concrete blocks</li> <li>• Rubber railroad crossings</li> <li>• Devulcanized/surface modified rubber</li> <li>• Heavy crash barriers</li> <li>• Tire reefs</li> <li>• Waste tire powder for recovery of oil spills</li> </ul>



# Proposed Waste Recycling Industry Categorization (Cont'd)

Category	Code	Industry	Feedstocks	Products
Category 10: Recycling of Waste Electrical and Electronic Equipment (WEEE)	R10.1	WEEE First Level Processing	WEEE	First level processing output
	R10.2	WEEE Second Level Processing	First level processing outputs	Second level processing output
	R10.3	WEEE Third Level Processing	Second level processing output	<ul style="list-style-type: none"> <li>• Plastics</li> <li>• Glass and other recycables</li> <li>• Precious metals</li> <li>• Base metals</li> </ul>

# Proposed Waste Recycling Industry Categorization (Cont'd)

Category	Code	Industry	feedstocks	Products
Category 11: Construction/ Demolition Waste Recycling	R11.1	Road Work Waste Processing	Road work waste	Asphalt; Concrete; Soil; Reinforcing Metal
	R11.2	Site Work Waste Processing	Site work waste	Soil; wood, including trees and brush; organic matter; sand; stone; concrete; pipe.
	R11.3	Demolition Waste Processing	Demolition waste	Mixed rubble, including wood, concrete, masonry, and steel; fixtures; etc
	R11.4	Construction Waste Processing	Construction waste	Scrap wood; roofing; wall board; insulation; flooring; ducts; pipe; packaging; fasteners; concrete; steel.
	R11.5	Renovation Waste Processing	Renovation waste	Scrap wood; roofing; wall board; insulation; flooring; ducts; pipe; fixtures; mechanical equipment; packaging; fasteners; concrete; steel.

# Proposed Waste Recycling Industry Categorization (Cont'd)

Category	Code		Industry	Feedstocks	Products
Category 12: Biomass Recycling	R12.1 Bio-Power Production Facilities	12.1.1	Anaerobic Digestion	WWTP sludge, OFMSW, animal manure	<ul style="list-style-type: none"> <li>Onsite power and/or heat</li> <li>Utility power</li> </ul>
		12.1.2	Direct Combustion	MSW, LFG, agriculture waste	
		12.1.3	Gasification	MSW, Agriculture waste	
		12.1.4	Pyrolysis	MSW, Agriculture waste	
	R12.2 Biofuels Production Facilities	R12.2.1	Biochemical (Bio refining)	OFMSW, agriculture waste	<ul style="list-style-type: none"> <li>Biodiesel</li> <li>Bioethanol</li> </ul>
		R12.2.2	Thermochemical (Chemical Refining)		
		R12.2.3	Fermentation	Bagasse,	
		R12.2.4	Transesterification	Animal fat, vegetable oil	

# Proposed Waste Recycling Industry Categorization (Cont'd)

Category	Code		Industry	Feedstocks	Bio-Products
(Cont'd) Category 12: Biomass Recycling	R12.3 Bio- Products	12.3.1	Bio-chemical (fermentation/plant extraction)	Food processing waste Sugarcane waste Other agriculture wastes	<ul style="list-style-type: none"> <li>• Coatings</li> <li>• Adhesives</li> <li>• Solvents</li> <li>• Textiles</li> </ul>
		12.3.2	Thermochemical (conversion of sugars)		<ul style="list-style-type: none"> <li>• Solvents</li> <li>• Coatings</li> <li>• Pharmaceuticals</li> </ul>
		12.3.3	Thermochemical (gasification/pyrolysis)	Agriculture waste, OFMSW	<ul style="list-style-type: none"> <li>• Chemicals</li> <li>• Biochar</li> </ul>
		12.3.4	Densification		<ul style="list-style-type: none"> <li>• Pellets/Briquettes</li> <li>• Construction materials</li> </ul>
		12.3.5	Transesterification (alcohol processing)	Vegetable oils Jetropa oil	<ul style="list-style-type: none"> <li>• Lubricants</li> <li>• Solvents</li> <li>• Resins</li> <li>• Plasticizers</li> <li>• Inks</li> <li>• Adhesives</li> </ul>

# Proposed Waste Recycling Industry Categorization (Cont'd)

Category	Code	Industry	Description
Category 13: Reuse and Remanufacturing Industry	R13.1	Computer and Electronic Appliance De- Manufacturers	Establishments which sort, grade and remanufacture used electronic appliances (e.g computers).
	R13.2	Motor Vehicle Parts (used)	Establishments which clean, sort, inspect and remanufacture used motor vehicle parts
	R13.3	Tire Retreaders	Establishments which sort, clean and remanufacture used tires by adding tread. These establishments produce crumb rubber as byproduct
	R13.4	Wood Reuse	Establishments which produce finished goods by cleaning and reprocessing used wood
	R13.5	Textiles Reuse	Establishments which clean, sort and grade used textile products
	R13.6	Material Exchange Services	Establishments which which manage waste exchange programs

# Proposed Waste Recycling Industry Categorization (Cont'd)

Category	Code	Industry	Description
Category 14: Support Businesses	R14.1	Recycling Equipment Manufacturers	Establishments which produce the primary equipment used by recycling businesses
	R14.2	Recycling Equipment Dealers	Establishments which trade recycling equipment and supplies
	R14.3	Consulting/ Engineering	Establishments which provide engineering design work and technical studies for the WRI
	R14.4	Vocational Education and Training (VET)	Establishments which provide VET to all WRI subsectors
	R14.5	Laboratories for Analysis and Quality Control	Establishments which provide laboratory analysis services to all WRI subsectors, including raw materials and product analysis and quality control