



Comprehensive Waste Management Strategy for ArRiyadh City



Executive Summary

January 2016



Glossary

ADA	ArRiyadh Development Authority	MEDSTAR	Metropolitan Development Strategy for ArRiyadh
AD	Anaerobic Digestion	MBT	Mechanical Biological Treatment
ATT	Advanced Thermal Treatment	MODON	Saudi Industrial Property Authority
BPEO	Best Practical Environmental Option	MOH	Ministry of Health
C&D	Construction and Demolition Waste	MOMRA	Ministry of Municipal and Rural Affairs
C&I	Commercial & Industrial Waste	MOU	Memorandum of Understanding
C&R	Collection & Recycling	MRF	Materials Recovery Facility
CHP	Combined Heat and Power	MSW	Municipal Solid Waste
CLO	Compost-Like Output	NES	National Environmental Standard
CWMS	Comprehensive Waste Management Strategy (or 'the Strategy')	PA&PD	Public Awareness & Professional Development
EFW	Energy From Waste	PME	Presidency of Meteorology and Environment
F&CR	Financing & Cost Recovery	PMU	Project Management Unit
G&I	Governance & Institutions	PPP	Public Private Partnership
GIS	Geographic Information System	RDF	Refuse Derived Fuel
IAP	Implementation Action Plan	SWM	Solid Waste Management
IVC	In-Vessel Composting	T&D	Treatment & Disposal
KPI	Key Performance Indicator	WMIS	Waste Management Information System
KSA	Kingdom of Saudi Arabia	WWTP	Waste Water Treatment Plant

1 Executive Summary

1.1 Overview

This document summarises ArRiyadh's Comprehensive Waste Management Strategy (CWMS or 'the Strategy') which has been developed by the ArRiyadh Development Authority (ADA) on behalf of the High Commission for the Development of ArRiyadh. The CWMS has been developed in response to the significant challenges and impacts caused by the City's rising levels of waste generation. It has been developed in partnership with close key stakeholders and draws upon 18 months of data collection, detailed analysis and action planning. The Strategy's vision statement, developed by the project stakeholders at an early stage of the project, sets out the overall aim of the strategy (see also Figure 1):

"The City of ArRiyadh will provide regional leadership in waste management, ensuring that the City's waste is managed as a resource whilst ensuring protection of human health and the environment.

ArRiyadh will seek to minimise the quantity of waste that the City generates, implement best available technologies for the treatment and recovery of value from waste, and will progressively reduce the quantity of material landfilled.

ArRiyadh's wastes will be managed in a spirit of partnership and in a manner which ensures the management framework will be underpinned by clearly defined roles and responsibilities, coupled with effective enforcement, and proactive partnership between government, business, and ArRiyadh's citizens."

Stakeholders also developed a series of principles which have been used as a basis for developing the detailed strategy.







The detailed strategy includes a series of objectives and specific actions which together form the Implementation Action Plan (IAP) for the strategy. The strategy forms the first stage in an on-going process of achieving the above vision and developing an integrated sustainable waste management system for ArRiyadh. The strategy will be reviewed every 5 years and will serve as an evolving framework for addressing the impacts of waste management in ArRiyadh and maximising the wider benefits of improved resource management.

1.2 The Development of the Strategy

In 2009, a review of ArRiyadh's sustainable development planning process ('MEDSTAR') identified that the City is facing increasingly significant challenges in the management of its wastes and that poor waste management is creating serious environmental damage. The MEDSTAR Review, undertaken on behalf of the High Commission for the Development of ArRiyadh, proposed the preparation of a City-level waste management strategy and proposed that:

"The 'wastes' generated by the activities of the City are resources to be recycled and reused in productive ways wherever possible, and should not be permitted to pollute the natural environment. In conjunction with this it is recognised that the High Commission will support the development of an Integrated Waste Management Strategy for ArRiyadh with this philosophy as its foundation, and will develop a program to then implement that strategy." MEDSTAR (2009)

The ADA subsequently began the development of a CWMS and, in 2013, commissioned an international sustainability consultancy to provide technical assistance and prepare the strategy.

The Strategy summarised in this document has been developed in close consultation with key stakeholders (see Box 1.1) and represents the conclusion of 18 months of data collection, analysis, options appraisal and action planning. Figure 2 illustrates the key tasks undertaken by the project teams at ADA and the consultant.

Box 1.1 Key stakeholders

Key Stakeholders	
Ministry of Municipal and Rural Affairs (MOMRA)	Ministry of Health (MOH)
Ministry of Commerce and Industry (MCI)	The Amanah
Presidency of Meteorology and Environment (PME)	Saudi Aramco
Saudi Industrial Development Company (MODON)	General Authority of Civil Aviation (GACA)
National Water Company (NWC)	Saudi Basic Industries Corporation (SABIC)
Saudi Electricity Company (SEC)	Saudi Customs and Excise

Figure 2 Key tasks undertaken as part of the road to CWMS development



1.3 The City of ArRiyadh

ArRiyadh, the capital of the Kingdom of Saudi Arabia (KSA), is one of the fastest developing and most affluent cities in the Middle East region. The population of approximately 6.5 million in 2015 is estimated to rise to around 8.5 million by 2030, an increase of over 31% in 15 years.

ArRiyadh's economic growth is expected to continue, with increasing urban expansion and a growing industrial sector. A number of major infrastructure and urban development projects are planned, including housing projects, new industrial developments and the construction of a major new metro network for ArRiyadh.

The rate of economic growth, coupled with changes in lifestyles and consumer behaviour, is driving significant increases in the quantities and range of waste types being generated by the city's residents and industry. This growth and development is placing increasing strain on ArRiyadh's limited waste management infrastructure and creating significant economic, environmental and social impacts.

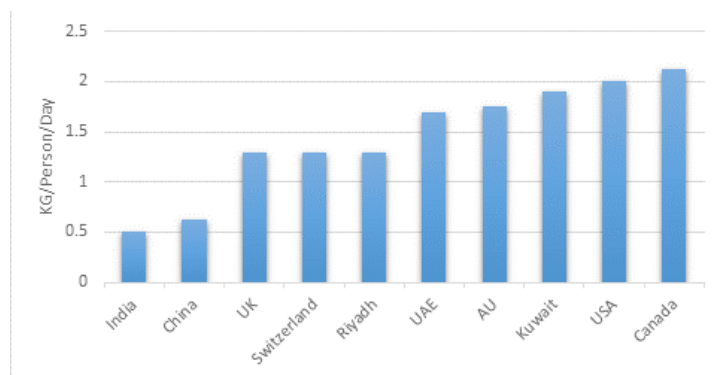


Figure 1
MSW Generation per capita

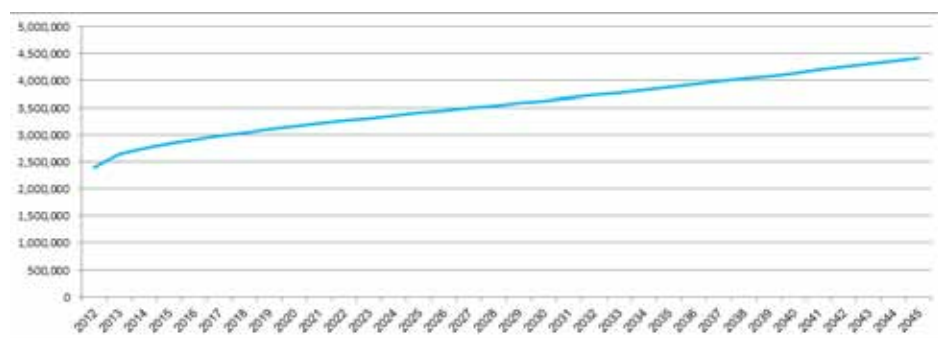
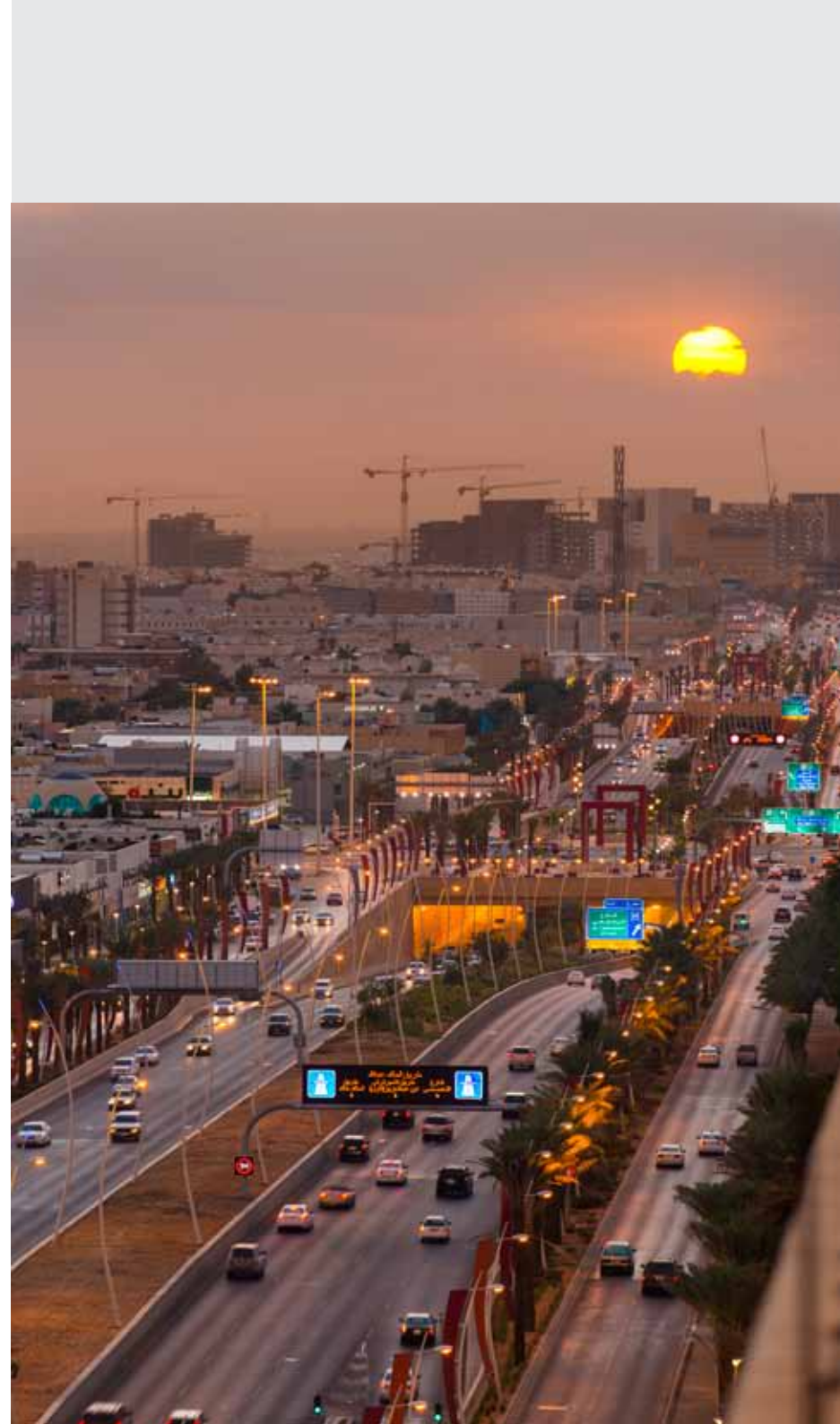


Figure 2 Municipal waste production per year

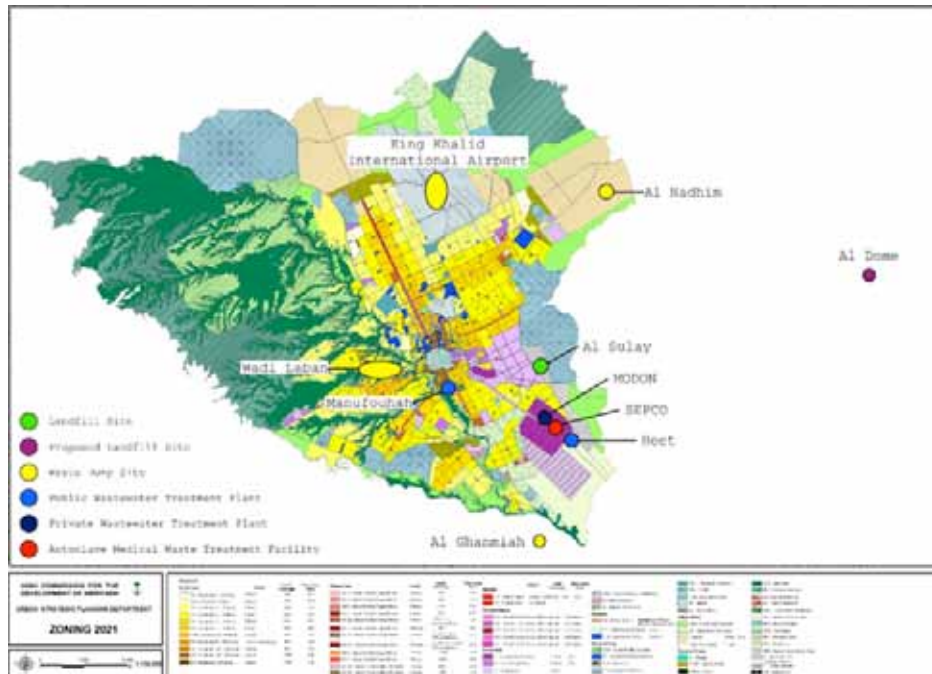


1.4 Waste Management in ArRiyadh

1.4.1 Current Context

Waste generated in ArRiyadh City requires systems and operations to manage the vast array of waste streams generated. These wastes range from municipal solid waste (MSW); commercial and industrial wastes (C&I); construction and demolition wastes (C&D), sewage sludge through to medical waste streams. The current mode of operation and adherence to international best practices is variable with some systems basic in nature and undeveloped whereas others exhibit some level of maturity in the approach. Whilst some support infrastructure and sites exist these are limited in nature, quite often with a lack of local capacity and competition in the market.

There is a significant need to move away from the poor practices that are seen within a number of the waste streams and all parts of the systems will require some form of immediate investment in the shorter term. In order to adhere to international best practice approach's a number of these areas will require significant capital and operational investment in the medium to long term. The following section provides a brief insight into each of the waste streams and the key issues faced by each of the sectors. Figure 3 below provides the location of the main operational sites that are discussed and referenced in the sections below.



1.4.2 Waste types, quantities and management practices

Introduction

The city of ArRiyadh generates over 50 million tonnes of estimated waste each year (Figure 4).

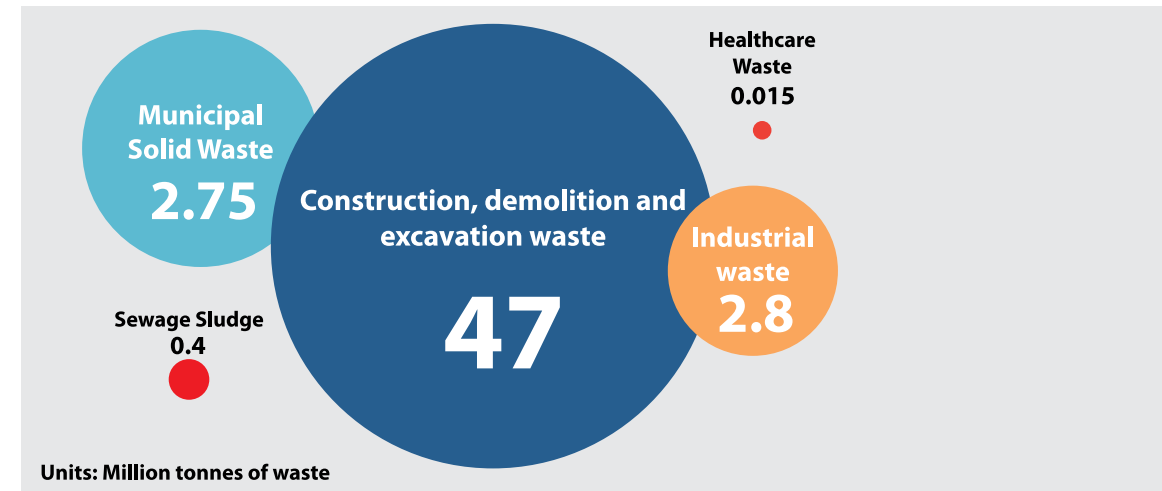


Figure 4 Estimated annual waste tonnages for ArRiyadh per sector

Municipal solid waste

Households and commercial businesses generated approximately 2.75 million tonnes of municipal solid waste (MSW) in 2015. Approximately 70% of this is from households, 30% is commercial waste and the remainder comprises other waste types such as bulky items (e.g. furniture) and building waste. Detailed waste characterisation undertaken in 2014 indicates that the MSW comprises a relatively high proportion of organic materials (57%), with the most readily recyclable materials (paper, card, plastics, metals and glass) making up a further 24% (see Figure 5).

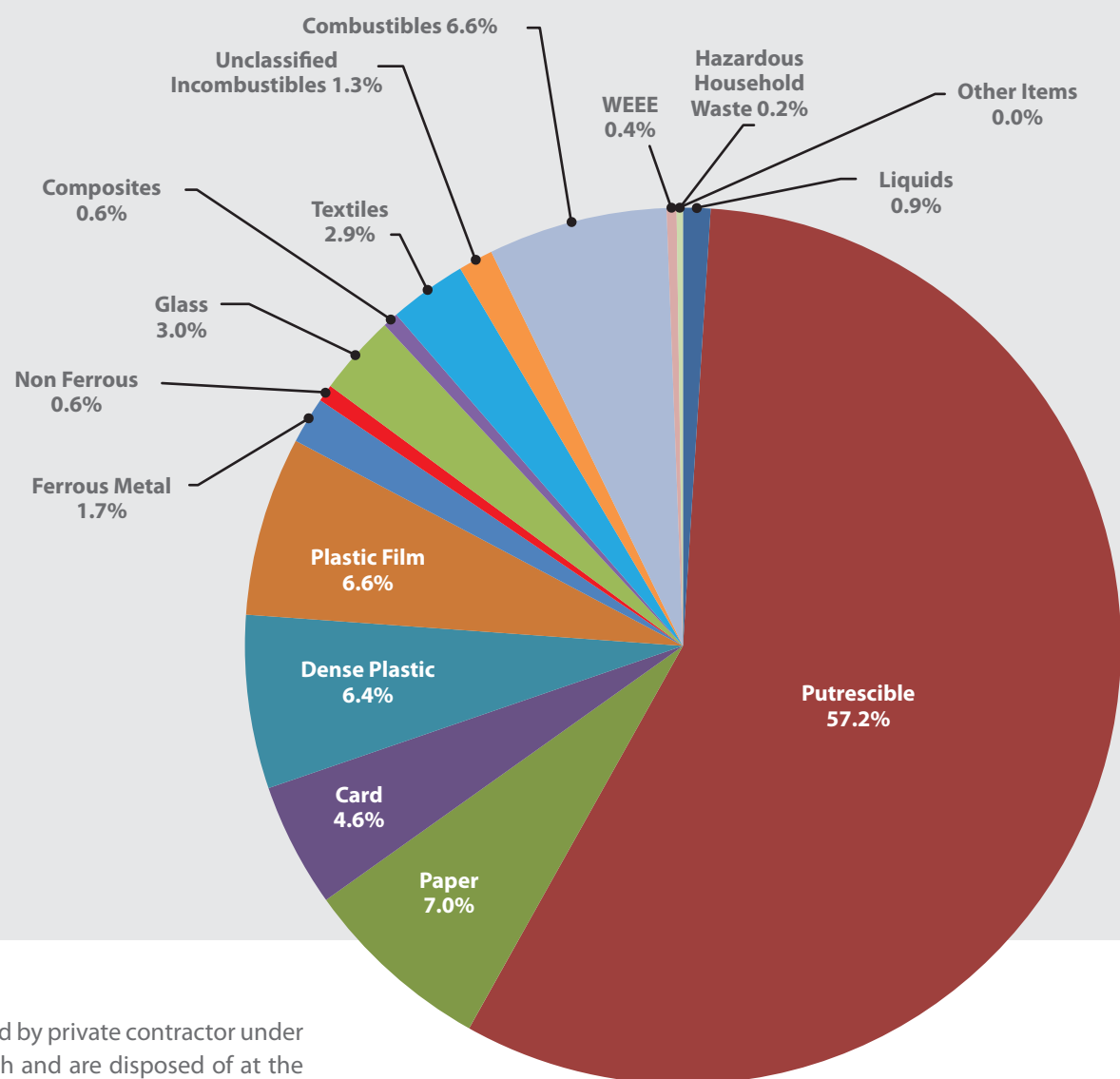


Figure 5 MSW composition

The wastes are collected by private contractor under contract to the Amanah and are disposed of at the Alsulay landfill.

Approximately 3% of these materials are processed by a materials recovery facility (MRF) which allows recovery of some paper, plastics, ferrous and non-ferrous metals. Recyclable materials are also extracted informally by waste-pickers operating at collection sites or the tipping face at the Alsulay landfill, a practice that poses significant risk of harm.

The Alsulay landfill itself does possess some engineering but it is not operated to international standards. There are also no measures in place to divert biodegradable materials from the landfill which has the potential for pollution and long term greenhouse gas generation.



Construction, demolition and excavation waste

Construction, demolition and excavation waste (C&D) represents the largest proportion, by mass, of ArRiyadh's waste (an estimated 47 million tonnes in 2015). These waste materials principally comprise inert materials such as rubble and soils, but this waste stream also contains non-hazardous materials such as wood, plastics and tyres, and potentially harmful materials such as asbestos, chemicals and oils.

Much of the City's C&D wastes are illegally dumped in vacant plots and on roadsides around the City. Estimates by the Amanah indicate that in excess of 10 million m³ of C&D wastes have been dumped illegally around the City.

Wastes that are disposed of formally are tipped at: the Amanah's dumpsites at Alghanmiah and Alnadhim; at one of a number of privately run dump sites in the City; or tipped at illegal dumpsites in the Wadi area of the City. These disposal sites are operated with either no, or very limited, controls and checks over the nature of wastes accepted, leading to inappropriate wastes being deposited at these sites (for instance, the disposal of wood, furniture and tyres at these sites is common). These sites also have no engineering controls, meaning that any leachate or gaseous emissions are released into the environment, potentially causing pollution. Alnadhim, in particular, has also historically been used for the disposal of mixed waste so is likely to pose a significant potential pollution risk.



Industrial wastes

ArRiyadh's industrial sector is estimated to generate approximately 2.8 million tonnes of industrial waste per year, including hazardous and non-hazardous solid and liquid wastes of a wide variety. When combined with commercial waste captured within the MSW stream equates to 3.6 million tonnes of commercial and industrial (C&I) waste.

The majority of solid non-hazardous C&I waste is collected by private contractors or deposited in municipality road side containers with MSW and disposed of in Alsulay landfill.

Saudi Industrial Property Company (MODON) operate a wastewater treatment plant at its Industrial City 2 in ArRiyadh. This facility receives and treats some of the wastewaters generated at the Industrial City. The remainder are containerised and dealt with by private sector waste management companies on behalf of the private industrial operators. In some instances this means that companies stockpile wastes until sufficient volumes are accumulated for the private sector to transport and treat at third party treatment facilities/locations. Non-hazardous liquid C&I wastes are treated at two sewage treatment plants in Manfouha and Heet, both in the south of the city. However, these sites are under considerable strain and, as a result, many industrial facilities are either stockpiling their liquid wastes or transferring them to private waste operators for treatment/disposal outside the city.



There is no hazardous waste treatment capacity in ArRiyadh. Some hazardous wastes are transported 400km to a hazardous waste facility in Jubail. Other hazardous wastes are disposed in hazardous dumpsites in Buqiy, located 50km south west of Dammam. Hazardous liquid effluent wastes are also transported outside ArRiyadh, 85km to Al-Kharg treatment facility on the south east ArRiyadh, while others are co-disposed with solid wastes in Alnadhim dumpsite.

However, illegal tipping of C&I wastes, both hazardous and non-hazardous, is widespread with hazardous waste in particular commonly dumped illegally due to the significant cost of transporting these wastes away from the City.

Recycling of some C&I waste materials is well-established in ArRiyadh, for instance, for cardboard, metals and waste oils. However, there is scope for increasing the quantity and types of materials recycled.



Healthcare wastes

The City's healthcare facilities generated an estimated 15,000 tonnes of healthcare waste in 2015. The majority (75%) of these wastes are non-hazardous, comprising wastes created by administrative, catering and daily maintenance activities. The remaining 25% comprises hazardous materials.

Healthcare wastes are collected by private contractor for treatment at the City's single autoclave facility prior to disposal at the Alsulay landfill. Each hospital tenders its waste management contracts separately, but supervised by Ministry of Health (MOH). Some healthcare waste is incinerated by the medical facilities themselves on the premises. ArRiyadh is in need of additional and alternative healthcare waste treatment capacity.



Sewage sludge

The City of ArRiyadh generates approximately 800,000m³ sewage per day which is currently processed at Manfouha, Heet and Alhair sewage treatment plants. Both of these facilities are operating significantly above capacity. A new plant is planned in Ban Ban with an expected capacity of 300,000m³ beyond 2020.

The total quantity of dewatered sludge produced is 400,000 m³/year.

The majority of this sludge is currently solar-dried in the Al Hair wastewater treatment plant (WWTP) facility – in a mostly uncontrolled way – and then stockpiled. In addition, lightly contaminated sewage waters (siphoned off from sewage sludge) are used for dust suppression at Alghanmiah dumpsite.



1.4.3 Regulations, Institutions and Financial Arrangements

Legal Framework

At the national level, KSA has a comprehensive legal framework for waste management. The General Environmental Regulations and the Solid Waste Law establish the key responsibilities for waste management, and the National Environmental Standards (NES) set out, in detail, many of the key principles for waste management (e.g. waste hierarchy, proximity principle and duty of care) and provide clear guidelines for managing waste in a manner which protects human health and the environment.

Responsibilities and Enforcement

The main responsibilities for implementing the requirements of this legal framework sit with:

- The Presidency of Meteorology and Environment (PME) which has overall responsibility for environmental protection and waste regulation
- The Ministry of Municipal and Rural Affairs (MOMRA) has the responsibility for strategic planning for waste management and for the delivery of municipal waste management services, although this latter responsibility is delegated to the Amanah
- The MOH has responsibility for the management of wastes from healthcare facilities
- The Saudi Industrial Property Authority (MODON) which has assumed responsibility for managing wastes within state-owned industrial cities

Unfortunately, however, these regulatory requirements are not stringently enforced in ArRiyadh as a whole. Illegal tipping and dumping is widespread. Compliance with the waste acceptance, classification and tracking system (a requirement of NES 8, 9 and 12) is poor and, in some cases, fraudulent (e.g. use of a single waste manifest for multiple movements of waste). As well as creating environmental impacts, this results in uncertainty as to where wastes are disposed and hinders effective management and regulation of the City's waste management system.

On a more general level, the principles of the waste hierarchy, proximity principle and best practical environmental option (BPEO) and duty of care (as required by NES 18) are not reflected in the City's current approach to waste management (see below for more information on these principles). The legal framework also requires the implementation of education and awareness initiatives for waste management. To-date these activities have been limited in ArRiyadh.

Financial arrangements

Waste management services and infrastructure in ArRiyadh are currently funded by government from general revenues. Private sector companies pay directly for waste collection and disposal services but there is no cost recovery from householders and commercial businesses. As such, there is no incentive to reduce the quantities of waste produced or manage it responsibly.

The extent of illegal dumping and tipping of C&I and C&D wastes in ArRiyadh suggests that industry is avoiding much of the cost of appropriate disposal and so is not paying the true costs of waste management. That being cost recovery that is reflective of the true costs of the management of the system including longer term costs such as monitoring, maintenance, rehabilitation as well as taxes and fines via policy imposition.

1.4.4 Gap analysis

As part of the strategy's development a thorough situational gap analysis was conducted. A summary of the key issues is provided here.

The review identified some key gaps and issues that the strategy will need to address, the most critical being issues associated with [1] the effective enforcement of regulations and [2] the need for clarity in the roles and responsibilities of institutions with regard to the City of Riyadh's waste management. Addressing these two fundamental issues will provide the basis for successfully acting on the other issues identified above (e.g. cost recovery and financial planning, improving waste collection, recycling and treatment services, and public engagement activities and training).



The table below summarises the gap analysis findings, highlighting the key areas for action and opportunity, which have become core themes of the strategy and its action plan.

Conceptual Element	Key issues
Governance, Institutions, Management and Regulation	<ul style="list-style-type: none"> • Legislation is not comprehensive. • Lack of adequate resources (financial and human). • Inadequate enforcement. • Poor definitions of roles and responsibilities for key organisations and institutions, leading to inefficiency in delivery. • No education, training and awareness-raising activity.
Sustainable Waste Collection and Recycling	<ul style="list-style-type: none"> • Ineffective collection system. • Levels of recycling are limited. • Waste tracking system ineffective. • Informal waste picking takes place on street and at collection sites around the city. • Mixing of hazardous waste with non-hazardous waste • Recyclables removed from residual waste prior to transfer to landfill.
Sustainable Waste treatment and disposal	<ul style="list-style-type: none"> • Illegal disposal of waste is common practice around the city. • Several uncontrolled dumps in use for disposing of a range of waste types. • Main municipal landfill is not operated to accepted international standards • Biodegradable waste is not diverted from landfill, resulting in surface and groundwater pollution and greenhouse gas emissions. • Co-disposal of both potentially recyclable materials and non-recyclables. • Poor application of the Proximity Principle. • Low levels of recycling and materials recovery. • Inadequate aftercare provisions for landfill. • A need for better training of healthcare staff on waste issues and assessment of existing healthcare waste treatment capacity. • Treatment facilities not available for specific waste streams. • Inadequate wastewater treatment and sewerage sludge disposal capacity.

Conceptual Element	Key issues
Economic sustainability	<ul style="list-style-type: none"> • Comprehensive information on the costs of operating Riyadh's waste management system is poor. • No cost recovery or incentives to encourage waste producers to reduce the quantities of waste produce and manage waste materials using options towards the top of the waste hierarchy. Waste is not treated as a resource.
Public awareness, engagement and professional training	<ul style="list-style-type: none"> • There are no public awareness and education campaigns currently taking place in Riyadh. • Staff delivering waste management services are poorly trained and qualified.

Table 1 Summary of gap analysis

In addition to the above, a further review was also conducted on the suitability of the waste classification scheme in use at present. The current scheme is detailed in the Presidency of Metrology and Environment (PM) National Environmental Standard 9 - Waste Classification. This waste classification standard is dated 01/05/1433H which corresponds to 24/03/2012G.

On review, the current system would appear to be relatively high level and if ArRiyadh is to develop a modern waste management approach, the current waste classification system will need to be improved. It is recommended that an approach similar to that of the European Waste Catalogue (EWC) be adopted. The European Waste Catalogue is made up of approximately 650 different codes divided into 20 chapters. Many of the chapters are industry based but some are based on materials and processes. Each of chapters has a two-digit chapter code from 01 to 20. Each chapter has one or more sub-chapters. These are identified by four digit codes, the first two digits of which are the chapter code. Within these sub-chapters there are codes for individual waste streams, each of which is assigned a six-digit code.

1.5 Assessing Future Options

The Approach

Identifying the most appropriate option for managing ArRiyadh’s solid waste in the future is a complex challenge.

Firstly, a detailed understanding of likely changes in the quantities and composition of wastes over 30 years was developed. A detailed modelling exercise has been undertaken to estimate the likely growth in ArRiyadh’s waste streams over the period 2015-2045 (see Figure 6 excludes C&D).

Secondly, potential options for the future management of the City’s waste were identified for assessment. The options assessed for the strategy are summarised in Box 1.2.

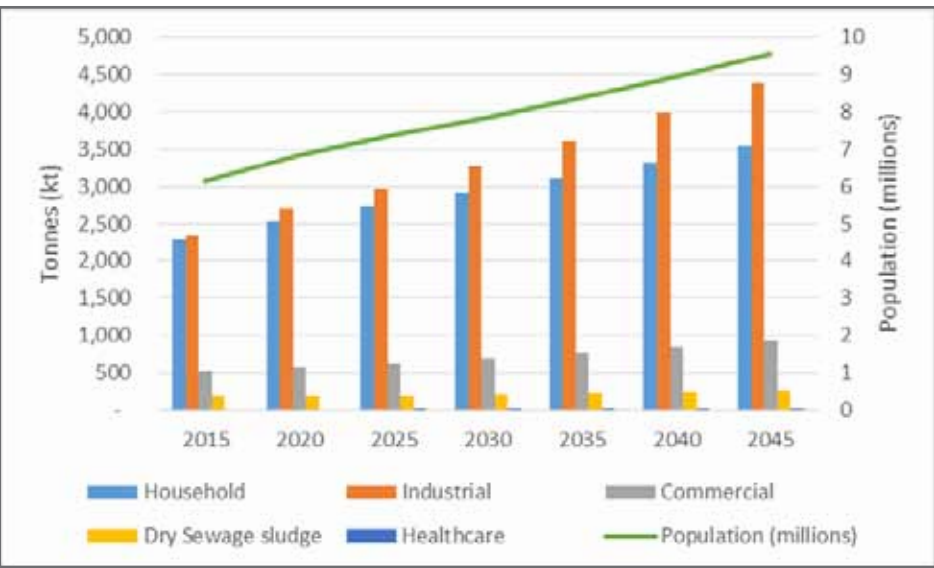


Figure 6 Anticipated waste arising changes

Summary of options appraised	
Waste collection options: <ul style="list-style-type: none">• ‘Business as usual’• Introduce recycling of dry materials• Introduce enhanced recycling of dry materials• Collect organic waste for anaerobic digestion (AD)• Collect organic waste for in-vessel composting (IVC)• Introduce both dry recycling and organic waste collection with AD	Waste treatment options <ul style="list-style-type: none">• ‘Business as usual’• Energy from waste (EFW) - electricity only• Energy from waste – combined heat and power (CHP) production• Advanced thermal treatment (ATT)• Mechanical biological treatment (MBT) with stabilised output to landfill• MBT producing refuse derived fuel (RDF) for combustion by EFW• MBT producing RDF for ATT• MBT combined with AD with stabilised output sent to landfill• MBT combined with AD with compost-like output (CLO) sold• MBT combined with IVC with CLO spread on land

Thirdly, these options were then assessed against an appropriate range of criteria which reflected stakeholders’ preferences and priorities. See Box 1.3.

Box 1.3 Summary of options appraisal criteria

Summary of options appraised criteria	
Technical deliverability <ul style="list-style-type: none">• Similar sites and scales world wide• Markets & outputs• Suitability for ArRiyadh• Flexibility Social/political issues <ul style="list-style-type: none">• Strategic compliance• Local environmental opportunities• Public acceptability	Economics <ul style="list-style-type: none">• Operation and capital costs Environmental <ul style="list-style-type: none">• Regulatory compliance• Climate change impact• Other environmental impacts• Recycling rate• Recovery rate



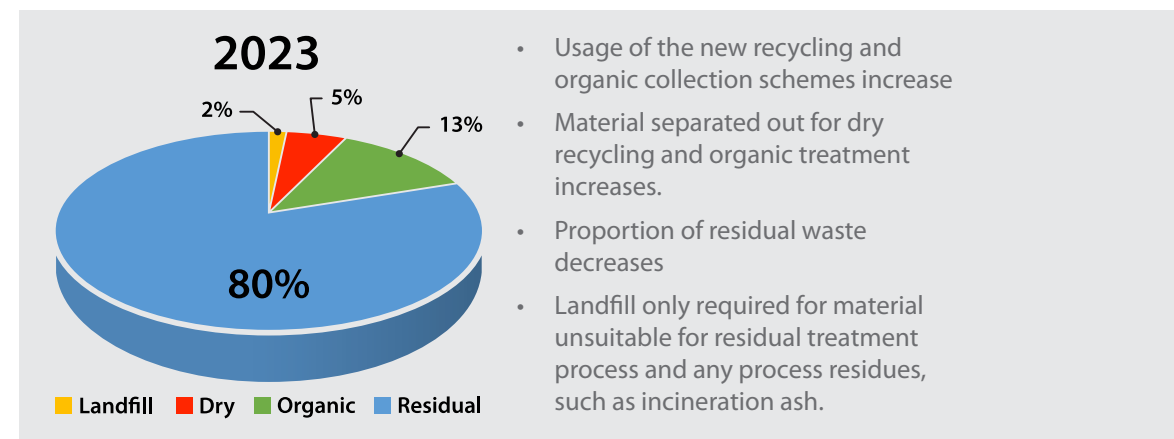
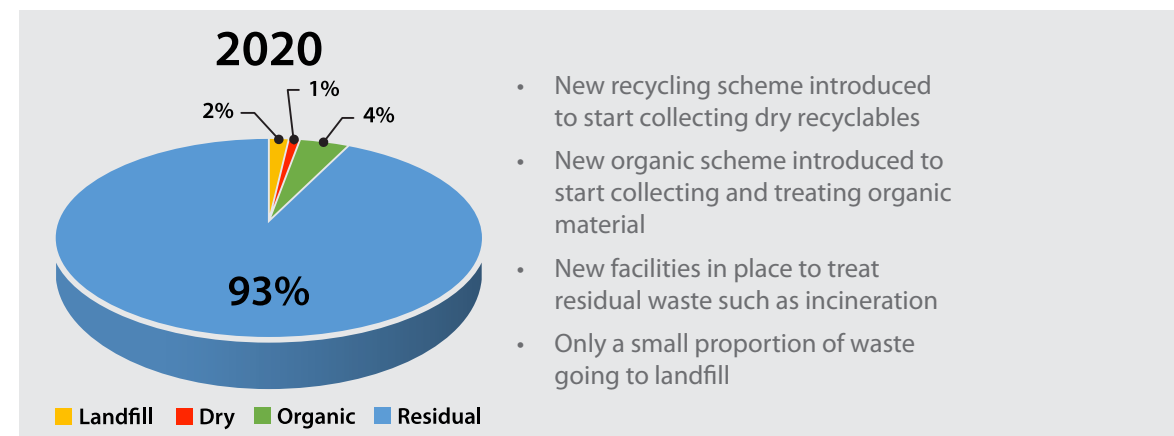
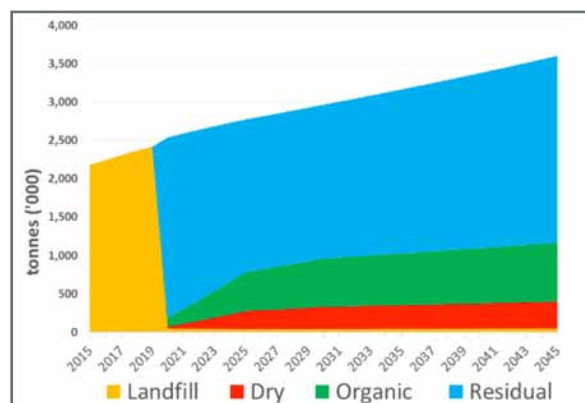
The Preferred Option

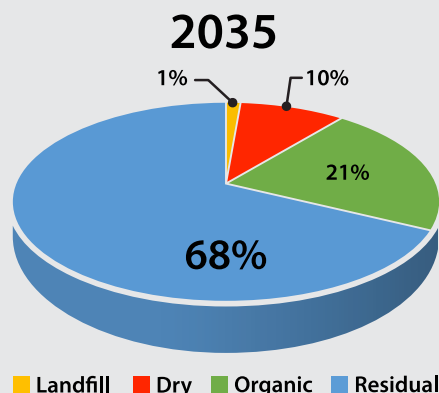
The preferred option identified by the appraisal comprises a combination of new waste collection and treatment services and infrastructure for different waste streams:

1. Development and maintenance of well-managed, engineered landfill capacity for industrial, construction, demolition and excavation wastes and a proportion household wastes (e.g. bulky wastes, tyres, inert materials)
2. Separate collection of recyclables from households and increased levels of recyclables collection from commercial and industrial premises
3. Separate collection of organic wastes from households, and commercial and industrial premises
4. Development of materials recycling capacity to allow collected recyclables to be sorted for subsequent reprocessing (0.6 Mt by 2045)
5. Development of organic waste treatment capacity (1.2 Mt by 2045)
6. Residual waste treatment by energy from waste (3.2 Mt by 2045)
7. Development of specialist recycling capacity for industrial wastes (0.7 Mt by 2045 Mt)
8. Development of hazardous waste treatment capacity for ArRiyadh
9. Increase healthcare waste treatment, likely to be incineration capacity (additional 16,000 tonnes)

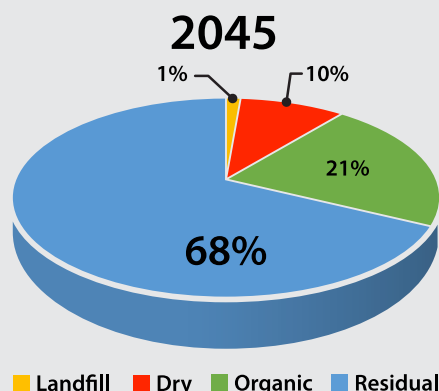
If this preferred technical option is implemented, the collection and treatment infrastructure will need to be phased in over time, as shown by Figure 7 and Figure 8 for household waste that is found in MSW.

Figure 7 MSW treatment requirements over time





- Usage of the new recycling and organic collection schemes further increases to maximum level through continued education and support
- Material separated out for dry recycling and organic treatment increases and additional facilities developed.
- Proportion of residual waste decreases.
- Landfill only required for material unsuitable for residual treatment process and any process residues, such as incineration ash



- Limited improvement in recycling and organic collection schemes
- Proportion of residual waste maintains the same but quantity will have increased as waste volumes increase over time due to growing population
- Landfill only required for material unsuitable for residual treatment process and any process residues, such as incineration ash
- Facilities built prior to 2020 will need refurbishment

1.6 Integrated solution

The new CWMS for the city of ArRiyadh represents an excellent opportunity to start developing an integrated approach for managing waste. Integration of collection and treatment across the different waste streams can have many positive benefits. The first, and possibly most important stage, is waste prevention and this should be encouraged across all waste streams. Reducing waste has significant positive benefits, ranging from cost avoidance through to a significantly reduced environmental impact.

Once waste is produced there are a range of management options available. Options that can improve reuse, recycling and composting should be prioritised before managing the residual waste.

At present there is a strong reliance on dump sites/landfill and this will continue whilst new facilities are developed for certain waste streams. These landfills should be modern fully engineered sites with gas and leachate extraction.

Evaluation of the different waste streams has created a list of preferred management routes, many of which overlap between the different waste streams and therefore permits them to be potentially treated at similar sites through an integrated approach.

Using information on the current arisings, preferred management routes, and growth projections, enables an overall estimate of the type and capacity of the likely new treatment infrastructure to be produced. This is shown for 2022, 2030 and 2045 in Figure 9, Figure 10 and Figure 11. The following projections show a steep rise in treatment infrastructure capacity as collection schemes are established with the subsequent necessity for increasing capacity.

Figure 9 Treatment Infrastructure Capacity for 2022

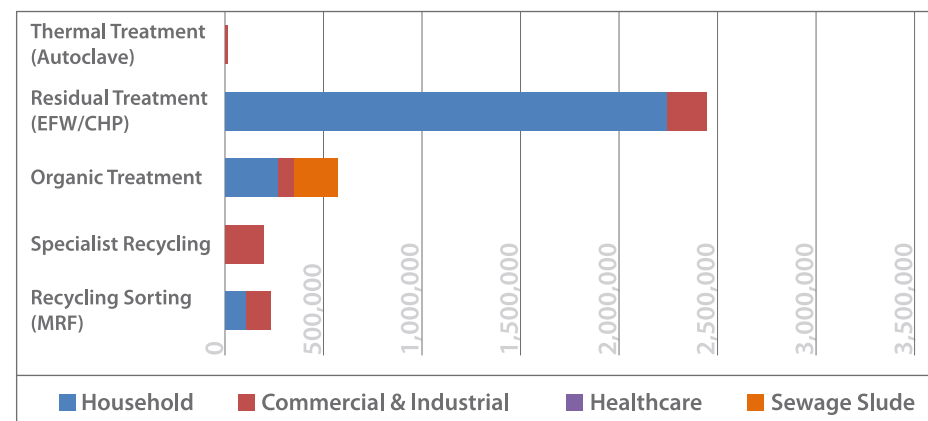


Figure 10 Treatment Infrastructure Capacity for 2030

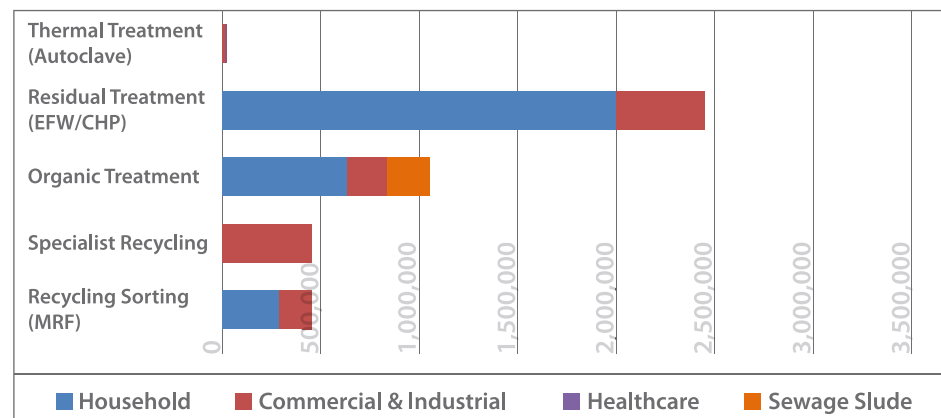
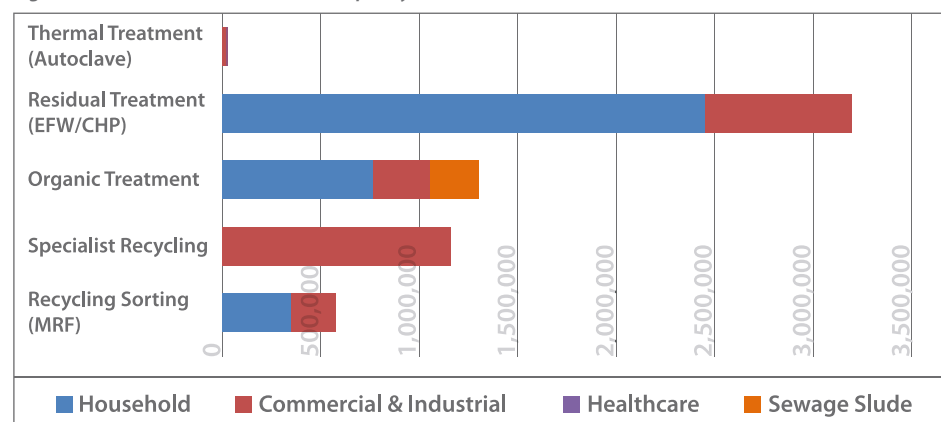


Figure 11 Treatment Infrastructure Capacity for 2045



Capacity increases over time due to waste growth and improved material segregation. The greatest capacity demand is for residual treatment facilities such as Energy from Waste or Combined Heat and Power (CHP). The main contributor is household residual waste, with additional waste potentially sourced from both the commercial and industrial waste streams. The capacity required for residual waste EFW or CHP is in the region of 3.2 million tonnes by 2045. If recycling and organic activities do not separate materials, then this will increase and recycling and composting capacity requirements will drop.

The organic treatment capacity required, potentially AD, is 1.3 million tonnes but this does assume a significant contribution from sewage sludge. If the sewage sludge continues to be managed in line with current methods (solar drying and landfilling), then the capacity requirement is likely to be about 1 million tonnes.

The specialist recycling of C&I waste will require in the region of 0.6 million tonnes of capacity. This will be for a range of individual specialist facilities managing the varying waste streams. Some of this maybe hazardous, but some use may could be derived depending on the individual nature of the waste stream and the overall quantity to make it viable.

The more generic mixed dry recycleate will go to MRFs and will require in the region of 0.60 million tonnes of capacity.

The healthcare waste management requirement is expected to reach 30,000 tonnes and, as such, requires an additional facility given the current capacity is 14,000 tonnes. This is likely to be incineration.

Table 2 shows the possible capacity required and number of sites.

Management method	Total (tonnes)	Possible facility capacity and number of sites
Recycling Sorting (MRF)	595,000	3 x 200ktpa OR 6 x 100ktpa
Specialist Recycling	1,200,000	Multiple sites for specialist recycling of certain waste fractions from industry
Organic Treatment	1,300,000	13 x 100ktpa Suggest multiple facilities in once location and some at sewage works
Residual Treatment (EFW/CHP)	3,200,000	4 x 825ktpa
Thermal Treatment (Autoclave)	30,000	Currently 14ktpa 1 x 16ktpa

There is approximately 50 million tonnes of C&D waste produced each year and although this figure will require validation and checking the overall volumes are expected to rise significantly from current levels over the next few years as development of the city continues.

The majority is disposed of to dumpsites and this is likely to continue. Better on site management and segregation of the materials should be promoted through dedicated skips for wood, metal, and inert materials. Crushing and baling can also be performed on site to make transport to the recycling facilities easier. Inert recycling plants should be considered to process C&D waste to produce secondary materials for other construction projects such as aggregates, sand, soil, and other recovered materials. Mixed waste could be sorted through transfer station or MRF facilities. Long term landfilling should only be used as a last resort for non-recyclable C&D waste. Moreover, hazardous materials should be sent to dedicated hazardous waste treatment facilities.

Within each waste stream there will be liquid wastes, which will include non-hazardous wastewater and hazardous effluents. The current quantity produced is unknown but the majority is expected to come from the industrial sector. Discharge of these effluents to the public sewerage system should be prohibited and specialist treatment will be required which will depend on the nature of the effluent.

With the exception of one waste oil recovery facility, there are no official treatment facilities for hazardous effluents in ArRiyadh and much of it is transported out of the city. MODON operates an effluent treatment plant in Industrial City 2. This facility is currently underutilised and ideally should be used to treat suitable waste streams, helping ensure waste is treated closer to the proximity of the ArRiyadh.



2 The Strategy

The Strategy Framework

The new CWMS for the City of ArRiyadh represents an excellent opportunity to develop an integrated approach to managing the City's waste, an approach which takes into account the different policy, service and infrastructure options available and the priorities of stakeholders.

It is also important to appreciate that the new waste collection services and infrastructure (discussed above) represent only part of an integrated waste management system. Equally important are the stakeholder, regulatory and financial aspects which will, in effect, determine the success (or failure) of the technical solution. These issues represent the remaining components of the strategy (see Figure 12). These components have been developed and agreed in consultation with key stakeholders.

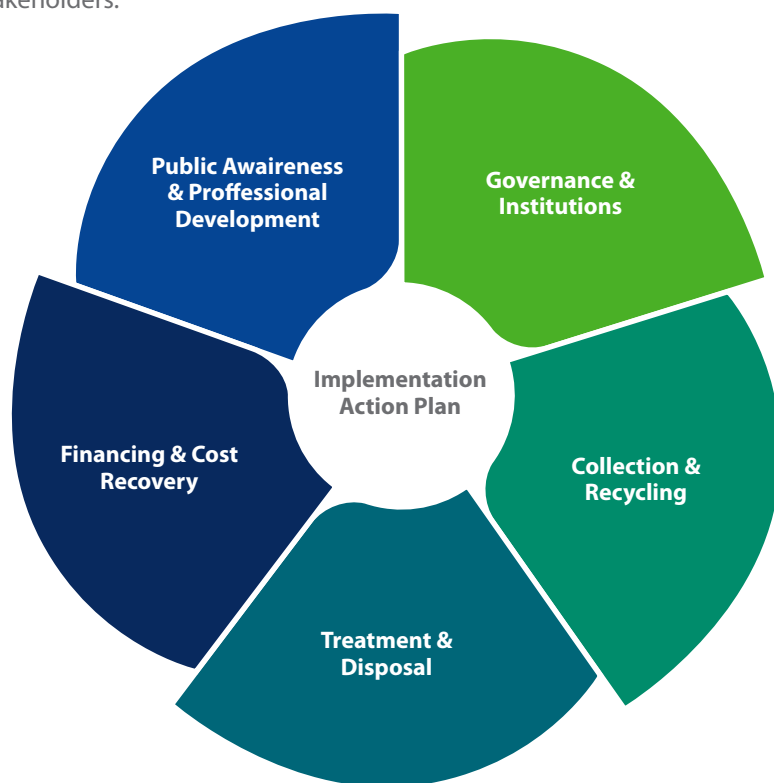


Figure 12 Summary of the five strategy components

The strategy is divided into two separate periods of time as set out below and in Figure 13.

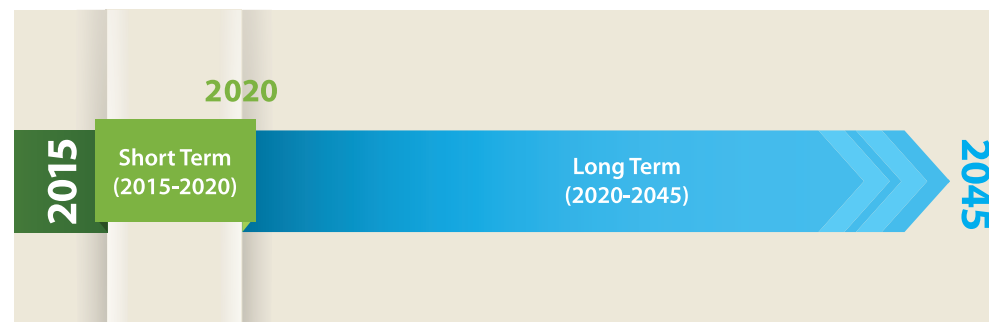


Figure 13 CWMS Timeframe Diagram

The Strategy's Objectives

The Strategy framework is divided into five Components which reflect the key building blocks necessary for developing a CWMS which meets international standards (see Figure 12). Although the Strategy has been divided up in this way, it must be recognised that all components are inter-dependent. Progress in one component will, by definition, affect progress in all other components.

Each strategy component is described below:

Governance & institutions

Governance relates to the processes of interaction and decision-making for implementing the waste strategy. Governance by allotted institutions will set the rules and ensure actions are undertaken, sustained and regulated. The allotted institutions shall also have the ability to hold appropriate delivery bodies accountable. To aid this there needs to be clearly defined responsibilities and accountability between agencies. The objectives identified for Governance and Institutions are aimed at driving the strategy's implementation and ensuring change from current practice. For example, this will require institutional skills and capacity building programmes; introduction of enforcement system and setting of a simple and effective penalty system; taking action on illegal dumping by improving enforcement of regulatory requirements; and, encouraging participation from private sector, including Public Private Partnership approaches. Additionally, updating the waste classification system and gathering more detailed data will be a key requirement going forward.

Collection & recycling

Collection and recycling covers the process from waste production at source, such as within households and businesses, through to appropriate management. The aim is the creation of a comprehensive and efficient waste collection services for all sectors. This will be through establishing appropriate separated recycling systems and markets for each waste sector and material. Another key aspect will be the introduction of waste prevention and reuse programmes.

Treatment & disposal

Within this component of the strategy framework the aim is to plan and develop appropriate treatment and disposal capacity for all waste streams. This will be done using a phased approach of feasibility studies and business case development. It will also be important to upgrade existing disposal site design and operation in line with national environmental standards and international best practice as an interim measure until the new facilities are complete.

The component also covers improving current operational management and rehabilitation of illegal/existing/closed waste disposal sites.

This part of the strategy framework will lead to diverting waste from dumpsites & landfills and recovering value through the appropriate application of waste treatment technologies.

Financing & cost recovery

In creating a long term sustainable waste management approach, ArRiyadh will need to develop a waste management budget system and consider the potential to move towards a full cost recovery system for waste management services. It will require harmonising the financing of the waste management system with other City-wide development policies to ensure that waste management services are financed and budgeted in a consistent way.

This will require the identification of secure sources for capital needed to invest in future waste management infrastructure and the allocation of sufficient budgets for monitoring, enforcement, training, and education activities (in line with delivering the strategic vision). Within this framework there will also be the promotion and establishment of markets for every aspect of waste management, e.g. recyclates, commercial collections and treatment facilities.

Public awareness & professional development

A key part of implementing this waste strategy is raising public awareness about waste and recycling, including actions the public can contribute with, such as reuse, reduction and using new collection schemes.

There will be a need to increase professional development of the waste industry in ArRiyadh. This can be done using a range of method but should also include the introduction of waste aspects in all levels of education from schools to University levels.

As well as the public, businesses will be required to start thinking more about their waste, by adopting and sharing best practice. Leading to reuse of waste as a resource between businesses and creating industrial symbiosis.

Through a process of consultation, discussion and analysis, a series of Objectives has been developed for each Strategy Component. These Objectives draw upon the key challenges identified during the data review stage. Objectives have been set for the Short Term (2016 – 2020) and for the Long Term (2021 – 2046). The Objectives are linked to Actions (providing the steps to be taken to reach the Objective in question) and Tasks (the detailed approach).

These short and long term Objectives, Actions and Tasks have been further examined to define suitable KPI's and determine how these should be measured to ensure accountability and progression of that Strategic Objective.

For each component, a series of objectives has been identified. These objectives reflect:

- the principles underlying the strategy
- the priorities identified by the review of the existing waste management system
- the preferred technical option

In essence, the objective's capture what the strategy is setting out to achieve over both the Short (5 years) and Long (30 years) terms. The objectives are summarised in Table 3 and Table 4.

Table 3 Strategy components and associated short term objectives

Component	Short Term Objectives
Governance & institutions	<ol style="list-style-type: none"> 1. Appropriate management and co-ordination to actively 'Drive' delivery of the ArRiyadh Waste Strategy. 2. Review defined roles and responsibilities and ramp up reinforcement. 3. Program to deal with waste Illegally dumped 4. Encourage competition from the private sector and establish the most applicable business models for each service element. 5. Unified information on waste management. 6. Introduction of waste minimisation programmes. 7. Establish reuse facilitation mechanisms to foster material reuse amongst businesses, industry and institutions.
Collection & recycling	<ol style="list-style-type: none"> 1. Extend waste collection service coverage for all priority waste streams. 2. Improve waste collection services and implement separate collection of recyclables. 3. Promote and adopt the principles of Duty of Care. 4. Phase out illegal dumping of waste. 5. Phase out ad-hoc waste picking at the kerbside, landfills and dumpsites.
Treatment & disposal	<ol style="list-style-type: none"> 1. Implement best practice waste treatment & disposal approaches. 2. Rehabilitate illegal/existing waste disposal sites. 3. Increase materials recovery and recycling capacity. 4. Ensure sufficient treatment and disposal capacity for residual waste arisings. 5. Delivering appropriate waste management solutions for other waste streams.
Financing & cost recovery	<ol style="list-style-type: none"> 1. Set cost-recovery policy targets for solid waste management (SWM) streams over the 30 year strategy period. 2. Investments – secure the investment levels required for SWM operators. 3. Wider policy context – achieve cost recovery for SWM services.
Public awareness & professional development	<ol style="list-style-type: none"> 1. Establish public awareness and education programme for ArRiyadh. 2. Improve knowledge of waste management operators and supervisors. 3. Establish SWM training and development mechanisms. 4. Waste management to form part of education system.

Table 4 Strategy components and associated long term objectives

Component	Long Term Objectives
Governance & institutions	<ol style="list-style-type: none"> 1. Strategy Review 2020. 2. Unified information on waste management. 3. Management of illegal dumping. 4. Achieve greater transparency and accountability. 5. Enhance government and private sector co-operation through ArRiyadh. 6. Enforcement.
Collection & Recycling	<ol style="list-style-type: none"> 1. Extend waste collection service coverage for all priority waste streams.
Treatment & disposal	<ol style="list-style-type: none"> 1. Review the performance and contribution to targets from support infrastructure (developed in the Short Term). 2. Construction and commissioning of infrastructure for residual MSW waste stream. 3. Planning, construction and commissioning of infrastructure for C&D waste stream. 4. Planning, construction and commissioning of infrastructure for C&I waste stream. 5. Planning, construction and commissioning of infrastructure for healthcare and hazardous liquid. 6. Planning, construction and commissioning of infrastructure for sewage sludge and sludge contribution from industrial wastewater.
Financing & cost recovery	<ol style="list-style-type: none"> 1. Costs – establish cost recovery policy and tariff calculation process. 2. Investment Plan 3. Wider Policy Context
Public awareness & professional development	<ol style="list-style-type: none"> 1. Communication and engagement throughout the Strategy implementation phase 2. Continue to build public awareness and education programme for ArRiyadh 3. Embed waste management issues into all aspects of education 4. Improve guidance for waste management operators and administrators. 5. Build upon SWM training and development mechanisms.

2.1 Putting the Strategy into Action

For each of the Strategy's objectives, a series of actions have been developed. Together these actions form the IAP for the strategy, defining the steps that will need to be taken to achieve the objectives and overarching strategy vision. Table 5 to Table 14 summarise the actions and individual tasks for each objective in the Short and Long Term IAP.

The short-term activities (see Figure 14) are particularly important because the short-term plan will be the key vehicle through which to maintain the momentum of the Strategy. In this respect, the short-term plan contains activities designed to mobilise stakeholders into action, combining preparatory work for major infrastructure and service developments with areas that can be progressed with relatively limited resources or finances.

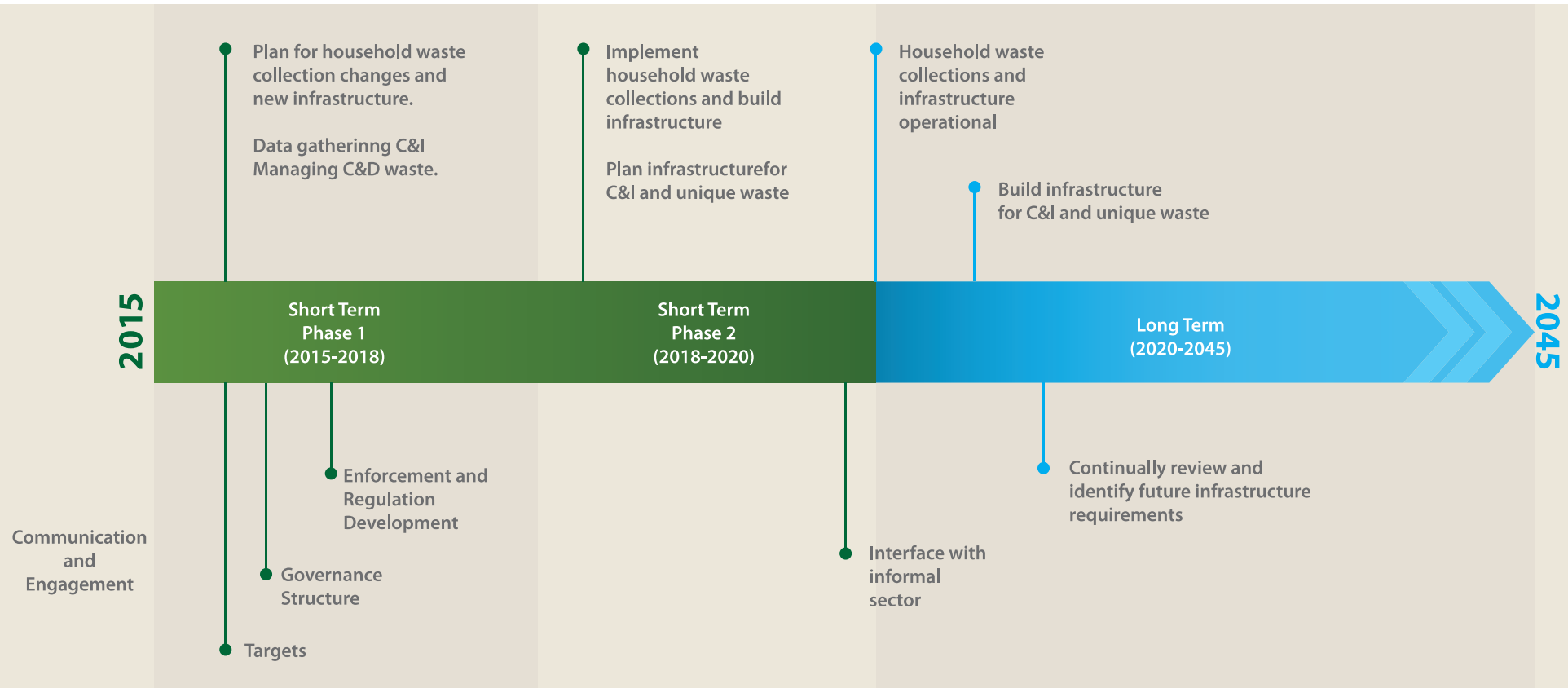


Figure 14 Priority Actions diagram

The following Figure 15 and Figure 16 represent a summary of the key objectives for the implementation of the strategy both in the short and long term.



Short Term (2015-2020)

Long Term (2020-2045)

Governance & Institutions

1. Management and co-ordination to actively 'Drive' delivery of the Waste Strategy.
2. Review defined roles and responsibilities and ramp up reinforcement.
3. Deal with waste illegally dumped.
4. Encourage completion from the private sector and establish the most applicable business.
5. Introduction of wasteminimisation programmes.
6. Establish reuse facilitation mechanisms.

Collection & Recycling

1. Extend waste collection service coverage for all priority waste streams.
2. Improve waste collection services and implement separate collection of recyclables.
3. Promote and adopt the principles of Duty of Care.
4. Phase out illegal dumping of waste.
5. Phase out ad-hoc waste picking at the kerbside, landfills and dumpsite.

Governance & Institutions

1. Implement best practice waste treatment & disposal approaches.
2. Rehabilitate illegal/existing waste disposal site.
3. Increase materials recovery and recycling capacity.
4. Ensure sufficient treatment and disposal capacity.
5. Delivering appropriate waste management solutions for other waste stream.

Financing & Cost Recovery

1. Set cost-recovery policy targets for solid waste management (SWM) streams.
2. Secure the investment levels required for SWM operators.
3. Achieve cost recovery for SWM services.

Public Awareness & Professional Development

1. Establish public awareness and education programme for ArRiyadh.
2. Improve knowledge of waste management operators and supervisors.
3. Establish SWM training and development mechanisms.
4. Waste management to form part of education system.

Figure 15: Summary of the key objectives for the implementation – short term

Long Term (2020-2045)

Governance & Institutions

1. Strategy Review 2020.
2. Unified information on waste management.
3. Management of illegal dumping.
4. Achieve greater transparency and accountability.
5. Enhance government and private sector co-operation through ArRiyadh.
6. Enforcement.

Collection & Recycling

1. Extend waste collection service coverage for all priority waste streams.

Treatment & Disposal

1. Review the performance and contribution to targets from support infrastructure (developed in the Short Term).
2. Construction and commissioning of infrastructure for residual MSW waste stream.
3. Planning, construction and commissioning of infrastructure for C&D waste stream.
4. Planning, construction and commissioning of infrastructure for C&I waste stream.
5. Planning, construction and commissioning of infrastructure for healthcare and hazardous liquid.
6. Planning, construction and commissioning of infrastructure for sewage sludge and sludge contribution from industrial wastewater.

Financing & Cost Recovery

1. Costs - establish cost recovery policy and tariff calculation process.
2. Investment Plan
3. Wider Policy Context

Public awareness & professional development

1. Communication and engagement throughout the strategy implementation phase.
2. Continue to build public awareness and education programme for ArRiyadh
3. Embed waste management issues into all aspects of education
4. Improve guidance for waste management operators and administrators.
5. Build upon SWM training and development mechanisms.

Figure 16: Summary of the key objectives for the implementation – long term

Governance and Institutions (G&I)

This component of the strategy is, in many ways, the most important. Clear definition of roles and responsibilities for both regulatory enforcement (to prevent illegal waste disposal activity) and for the delivery of the range of waste-sector projects will be critical for the successful delivery of the strategy. This component of the strategy also provides an opportunity to define and progress some initiatives that will maximise the broader benefits of an integrated waste management system for ArRiyadh including, for example, developing waste prevention, reuse and industrial symbiosis programmes and engaging the private sector.

The CWMS for ArRiyadh encompasses the following key governance principles:

- The need to simplify administrative structures with the aim of achieving, as far as possible, “single source accountability” for the tasks to be undertaken
- The clear definition of roles and responsibilities between the various entities involved in the waste management system
- The identification and development of opportunities to enhance co-operation through ArRiyadh across the private/public sectors and across sub-regional Hays.
- The introduction of greater transparency and accountability to the public regarding the provision of services, promoting an open and honest culture, providing information and data to the public to inform and alter their behaviours, encouraging the private sector to be more pen in providing information across the sectors
- The encouragement of participation from the private sector through open and transparent tendering process, the establishment of public private partnership waste management companies that provide all waste management services should also be considered
- Implementation of the legal framework for monitoring waste management services with the introduction of relevant sanctions by the local authorities
- The creation of unified waste management information

The objectives of the strategy, have a series of key supporting Actions as set out in Table 5 and with more details on the specific tasks to meet the KPIs discussed in the section below.

Table 5 Short Term GI&M Actions

Objective	Actions
1. Appropriate management and co-ordination to actively 'Drive' delivery of the ArRiyadh Waste Strategy	<ol style="list-style-type: none"> 1. Appoint single Lead Agency – Project Management Unit (PMU) for the ArRiyadh Waste Strategy. 2. Gain appropriate support and engagement from the Key Delivery Agencies. 3. Ensure integration of strategy with wider activities. 4. Gap analysis & compliance review. 5. Establish delivery plan. 6. Report performance in line with agreed parameters. 7. Enhance capacity building.
2. Implement roles and responsibilities and ramp up reinforcement	<ol style="list-style-type: none"> 1. Promote better co-operation among agencies with waste management responsibilities in their mandate by undertaking a mandate mapping exercise. 2. Achieve greater transparency and accountability. 3. Collate, manage data and information and share this openly in fulfilling individual and collective responsibilities on these objectives. 4. Define legislative requirements of all stakeholders. 5. Ensure appropriate resources and capacity of all stakeholders. 6. Achieve better value for money and re-direct savings into priority delivery. 7. Review the existing penalty system. 8. Ramp-up enforcement activities to prevent illegal dumping.
3. Management to deal with waste illegally dumped	<ol style="list-style-type: none"> 1. Prepare a management and investment programme. 2. Prepare technical remedial programme. 3. Active management of remedial programme.
4. Encourage competition from the private sector and establish the most applicable business models for each service element	<ol style="list-style-type: none"> 1. Determine current contract arrangements. 2. Review business models for service delivery. 3. Gain private sector input into planning. 4. Define key elements of the services that will be required. 5. Set performance KPIs for the service elements for compliance with strategic directions relating to service delivery. 6. Refine contract arrangements so that KPI adherence is enhanced. 7. Contractual enforcement. 8. From 2018, new contracts to be let to private sector

Objective	Actions
5. Unified information on waste management	<ol style="list-style-type: none"> 1. Establish an automated data submission mechanism to collect and process, data at existing and proposed infrastructure. 2. Ensure the system holds comprehensive, verified and robust data.
6. Introduction of waste minimisation programmes (WMP)	<ol style="list-style-type: none"> 1. Define WMP. Preparation of action plan and targets. 2. WMP reviews. 3. WMP financial initiatives.
7. Establish reuse facilitation mechanisms to foster material reuse amongst businesses, industry and institutions	<ol style="list-style-type: none"> 1. Consult and provide suggestions on the changes needed to establish reuse. 2. Regulatory instruments developed to drive reuse. 3. Develop financial instruments to encourage reuse. 4. Introduce the principle of 'extended producer responsibility' to encourage the reuse of certain waste streams.

Once the main mechanisms, delivery agencies and roles and responsibilities have been set in the short term and the CWMS is under development, the GI&M tasks for the long term revolve around continued co-operation with the KSA National Waste Management Strategy (and other regional policies), developing the CWMS in reaction to lessons learned over the short term, monitoring and managing the now closed historic dumpsites, ensuring the new infrastructure for T&D is constructed and commissioned and maintaining the WMIS (as shown in Table 6).

Table 6 Long Term GI&M Actions

Objective	Actions
1. Strategy Review 2020	<ol style="list-style-type: none"> 1. Overarching Waste Strategy Review. 2. Review strategy tasks. Revise as appropriate. Define impacts upon planning and budgets for individual work streams and overall project. Report on changes to the High Commission of ArRiyadh every 5 years. 3. Initial prioritisation of timelines for delivery of all long term Actions. Ongoing review of priorities as required but at least every two years after initial period. 4. Report performance in line with agreed parameters to the PMU. 5. Track progress against the agreed programme of capacity building and training.

Objective	Actions
1. Strategy Review 2020	<ol style="list-style-type: none"> 1. Overarching Waste Strategy Review. 2. Review strategy tasks. Revise as appropriate. Define impacts upon planning and budgets for individual work streams and overall project. Report on changes to the High Commission of ArRiyadh every 5 years. 3. Initial prioritisation of timelines for delivery of all long term Actions. Ongoing review of priorities as required but at least every two years after initial period. 4. Report performance in line with agreed parameters to the PMU. 5. Track progress against the agreed programme of capacity building and training.
2. Unified information on waste management	<ol style="list-style-type: none"> 1. Continued monitoring of data, and performance of the Waste Management Information System (WMIS).
3. Management of illegal dumpsites	<ol style="list-style-type: none"> 1. Long term programme for management and monitoring of the now 'closed' illegal dumpsites.
4. Achieve greater transparency and accountability	<ol style="list-style-type: none"> 1. Continue to collate and manage data and information and share this. 2. Review the WMIS performance and adequacy.
5. Enhance government and private sector co-operation through ArRiyadh	<ol style="list-style-type: none"> 1. Ensure continued integration of strategy with wider activities regionally and nationally. 2. Alignment with National Waste Management Strategy (once established). 3. Continued co-operation with the wider ArRiyadh Waste Strategy Stakeholder Group. Consider the potential to expand to include additional groups.
6. Enforcement	<ol style="list-style-type: none"> 1. Continue enforcement activities to prevent illegal dumping.

Collection and Recycling (C&R)

At a basic level, a comprehensive and properly functioning collection system is an essential public service which will protect the environment and human health by keeping streets clean and preventing illegal dumping of waste. Transforming a basic collection system into a system incorporating separate collection of recyclable materials and organic fractions will allow a step change in recycling performance and recovery.

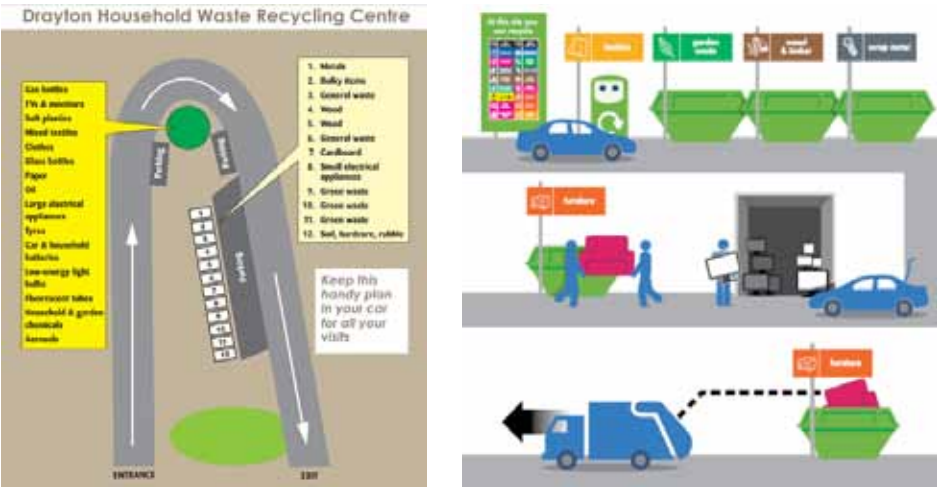


Table 7 Short Term C&R Actions

Objective	Actions
1. Extend waste collection service coverage for all priority waste streams	<ol style="list-style-type: none">1. Set targets for improvements to services in served areas (for example bin capacity, locations, litter and odour).2. Expand services to unserved areas (using the new transfer stations).3. Establishment of 'bring sites' within the city.4. Promote recycling of C&D materials.5. Bulky waste (e.g. large household appliances and furniture) collection system.
2. Improve waste collection services and implement separate collection of recyclables	<ol style="list-style-type: none">1. Improve the effectiveness/efficiency of container and vehicle combination.2. Designing and implementing a new bin network.3. From single, to 2 bin, to 3 bin collection system.4. Further develop private sector participation in recycling and recovery activities.
3. Promote and adopt the principles of Duty of Care	<ol style="list-style-type: none">1. Promote and adopt Duty of Care principles and system in line with international best practice:<ul style="list-style-type: none">- Producer responsibility and accountability- Capture data and provide an audit trail (quantity, quality, treatment and/or final destination)- Formal, regular reporting to PME- Protecting sector workers and the environment (health, safety and sustainability) <p>Ensure system is auditable and with associated fines in place.</p>
1. Phase out illegal dumping of waste	<ol style="list-style-type: none">1. Achieve greater control of the movement of waste around the city.2. Establish industry working groups for priority waste stream sectors.
5. Phase out ad-hoc waste picking at the kerbside, landfills and dumpsites	<ol style="list-style-type: none">1. Make the practices illegal.2. Assess the potential impact upon the livelihoods of individuals that would be affected.3. Control (restrict) access to the dumpsites.

Table 8 Long Term C&R Actions

Objective	Actions
1. Extend waste collection service coverage for all waste streams	<ol style="list-style-type: none"> 1. Further education and engagement of C&I and C&D sectors and expanding areas. 2. Across all waste streams, identify additional materials that could be collected and treated in the future.

Treatment and Disposal (T&D)

Once minimisation and reuse, and then source separation, have been undertaken, the remaining materials are residual waste. This residual waste must be dealt with and either treated further and/or then disposed of. Effective waste treatment and disposal is an essential component of waste management services and one which influences public health, environmental protection and the urban landscape.

Illegal dumping of C&D, and to a lesser degree of C&I waste, is a common occurrence in ArRiyadh as a result of a lack of public awareness and/or the desire to avoid payment of collection and disposal fees for wastes. Improved collection services and public awareness are therefore integral to improving waste disposal by reducing this illegal dumping.

The assessment of the current design and operation of the dumpsites in ArRiyadh revealed a number of significant deficiencies, including a lack of: landfill gas collection; leachate management; daily cover; compaction; and segregation of different waste types (e.g. hazardous). In effect, and from an international perspective, many would be classed as dumpsites and not landfills. The following Objectives (see Table 9) have been developed to overcome the inadequacies of current disposal methods and bring about the continual improvement of waste treatment and disposal over the strategy period.

The Phase 1 and Phase 2 Objectives and Actions are laid out in overview in Table 5 and Table 6 and in detail in Table 9 and Table 10, with more specific Task and KPI details in the text below.

Effective waste treatment and disposal is an essential component of waste management services and one which influences public health, environmental protection and the urban landscape.

Table 9 Short Term T&D Actions

Objective	Actions
1. Implement best practice waste treatment & disposal approaches	<ol style="list-style-type: none"> 1. Comply with the Options Appraisal analysis on suitable technologies for each waste stream. 2. Improve existing dumpsite operations (for the immediate short term). 3. Introduce a fully engineered landfill in line with international best practice (National Environmental Standard (NES 16)).
2. Rehabilitate illegal/ existing waste disposal sites	<ol style="list-style-type: none"> 1. Survey location of all illegally deposited wastes around the city and all historical and existing dumpsites. Enter into Geographic Information System (GIS). 2. Undertake programme of illegal waste deposit clean-up.
3. Increase materials recovery and recycling capacity	<ol style="list-style-type: none"> 1. Construction of infrastructure for effective and efficient recovery of materials from the waste stream ('recycling city'). 2. Develop new transfer stations.
3. Ensure sufficient treatment and disposal capacity for residual waste arisings	<ol style="list-style-type: none"> 1. Monitor usage at existing dumpsites and new engineered landfills once operational. 2. Assess technical, procurement and financing options for securing new residual treatment and disposal arrangements. 3. Procure treatment facilities.
3. Delivering appropriate waste management solutions for other waste streams	<ol style="list-style-type: none"> 1. Improve sector knowledge of waste streams generated. Understanding hazardous and/or difficult waste. 2. Improve the availability of C&I treatment infrastructure.



Table 10 Long Term T&D Actions

Objective	Actions
1. Review the performance and contribution to targets from support infrastructure (developed in the Short Term)	1. Review the performance of support infrastructure compared to the modelled residual MSW treatment options.
2. Construction and commissioning of infrastructure for residual MSW waste stream	1. Survey location of all illegally deposited wastes around the city and all historical and existing dumpsites. Enter into Geographic Information System (GIS). 2. Undertake programme of illegal waste deposit clean-up.
3. Planning, construction and commissioning of infrastructure for C&D waste stream	1. Feasibility studies (including surveys, site selection and preparation). Infrastructure phasing designs. Business Case Development. Implementation plans for development.
4. Planning, construction and commissioning of infrastructure for C&I waste stream	
5. Planning, construction and commissioning of infrastructure for healthcare and hazardous liquid	
6. Planning, construction and commissioning of infrastructure for sewage sludge contribution from industrial wastewater	



Financing and Cost Recovery (F&CR)

Appropriate budgets and investment for waste management is essential to sustain operational and capital costs.

The CWMS for ArRiyadh encompasses the following key principles for Financing and Cost Recovery:

- An effective cost recovery policy is essential to achieving a sustainable system, thus improving and developing waste management practices in ArRiyadh
- The cost recovery policy will be designed to recover an appropriate level of the total costs of providing waste services, including operation, maintenance and capital depreciation
- To be successful, the cost recovery strategy will also require reform in the financial policy framework of the city, within which SWM operators work

The review of the current situation found that, in summary, current standards of waste management are unacceptable and, to improve these standards, significant capital investment is required.

The baseline review suggests that the existing waste management system for MSW is funded from the general budget alone. Households make no contribution to the cost of providing the services, the financing being provided by government from the general budget.

The central thrust of the financing and cost recovery component is to move towards a financially sustainable system for the city, one based on the polluter pays principle whereby users pay cost recovery tariffs. The ultimate aim of this cost recovery strategy component is to help the city of ArRiyadh deliver solid waste management services that are financially sustainable.

ArRiyadh will need to prepare an investment programme to attract investments into the waste management sector, service providers must improve management and operational performance by meeting financial planning goals and performance targets, and there is a need to improve the capacity of service providers to undertake long-term planning, to prepare annual budgets, to measure and track costs over time, to improve cost control, to measure performance, and to calculate realistic tariffs.

Service providers will adopt cost accounting and calculate service costs based on normal commercial principles. In this respect, service providers should formulate true cost recovery tariffs for different classes of user, and introduce it progressively over time. That being cost recovery that is reflective of the true costs of the management of the system including longer term costs such as monitoring, maintenance, rehabilitation as well as fines via policy imposition.

The cost recovery strategy will therefore pursue the objectives in Table 11 which are designed to address the problems of SWM operators and to take on board the key issues raised by its central stakeholders.

Table 11 Short Term F&CR Actions

Objective	Actions
1. Set cost-recovery policy targets for SWM streams over the 30 year strategy period	<ol style="list-style-type: none"> 1. Study with a focus on financial implications, conducted for each waste stream. Aim to determine the most appropriate financial framework mechanisms. 2. Establish cost recovery policy and tariff calculation process. Develop cost framework which will determine approaches to meet short and long term strategic objectives. 3. Review all possible Business Models that could be adopted for the different waste streams and mechanisms (e.g. PPP)

Objective	Actions
2. Investments – secure the investment levels required for SWM operators	<ol style="list-style-type: none"> 1. Establish contracts between SWM operators and private customers (e.g. C&I, C&D, medical, sewage sludge and sludge contribution from industrial wastewater) to improve advance payments for SWM charges. 2. Establish appropriate charging procedures for the collection of cash payments by the budgetary institutions for SWM fees. 3. Secure capital and recurrent costs for the proposed infrastructure. 4. Undertake an affordability and willingness to pay survey for householders and C&I businesses.
3. Wider policy context – achieve cost recovery for SWM services	<ol style="list-style-type: none"> 1. Develop a cost recovery policy which creates an institutional framework that allows the finances of the waste operators to improve.



Table 12 Long Term F&CR Actions

Objective	Actions
1. Costs – establish cost recovery policy and tariff calculation process	1. Evaluate existing cost recovery policy against the short term recommendations.
2. Investment plan	1. Implement approved business models for all streams.
3. Wider policy context	1. Implement approved cost recovery policy.

Public Awareness and Professional Development (PA&PD)

Increased public awareness is crucial if the proposed CWMS for ArRiyadh is to work. In this respect, the key stakeholders should support the development of a Public Awareness Raising and Education (PA&E) Campaign to encourage greater participation by the public in municipal waste services, and to change their perceptions of waste production and littering.

The following objectives in Table 13 and Table 14 are designed to provide the necessary supporting information to the public and other stakeholders in order to facilitate the successful implementation of the CWMS and to raise the profile of SWM in the city.

Increased awareness and training will be critical to encourage greater participation by the public and business in effective waste services, and to build capacity in the skills that will be needed to deliver an integrated waste management system which meets international standards.

Table 13 Short Term PA&PD Actions

Objective	Actions
1. Establish public awareness and education programme for ArRiyadh	<ol style="list-style-type: none"> 1. Communicate and inform stakeholder groups (public and private) as to the waste management issues faced by the growing city. 2. Raise the profile and image of the city's waste management strategy. 3. Create a clear identity representing good waste management practice. 4. Manage expectations of the public and other stakeholder groups. 5. Promote volunteering and recycling/reuse social networks. 6. Increase public awareness and gain support for recycling initiatives and use of recycling stations.
2. Improved knowledge of waste management operators and supervisors	<ol style="list-style-type: none"> 1. Good practice guidance documents to meet existing and new waste management legislation, based upon international best practice. 2. Produce guidance for the C&D sector to improve C&D waste reductions, recycling and reuse.
3. Establish SWM training and development mechanisms	<ol style="list-style-type: none"> 1. Dissemination of best practice, training, certification, accreditation, management, working groups. 2. Establish an on-going training programme to build city-wide training capacity for waste management operatives. 3. Specific training courses in key areas e.g. contract management.
3. Waste management to form part of the education system	<ol style="list-style-type: none"> 1. Incorporate the waste management concept into the school curriculum. 2. Waste management modules and courses at University level

Table 14 Long Term PA&PD Actions

Objective	Actions
1. Communication and engagement throughout strategy implementation phase	1. Agree communication and engagement campaign for all sectors with relevant stakeholders
2. Continue to build public awareness and education programme for ArRiyadh	1. Maintain the profile and image of the city's waste management strategy. 2. Manage expectations of the public and other stakeholder groups. 3. Continued education and engagement with householders to increase the dry recycling and organic waste separately collected. 4. Continue to inform and engage the public to ensure materials recycled at the kerbside are of suitable quality.
3. Embed waste management issues into all aspects of education	1. Continue to incorporate waste management into the school curriculum. 2. Waste management modules and courses at University level.
4. Improve guidance for waste management operators and administrators	1. Good practice guidance documents to meet existing and new waste management legislation, based upon international best practice. 2. Maintain training programmes of city-wide training capacity for waste management operatives
5. Build upon SWM training and development mechanisms	1. Specific training courses in key areas e.g. contract management. 2. Dissemination of best practice, training, certification, accreditation, management, working groups.

2.2 The Implementation Action Plan

An IAP has been developed for the Strategy. The IAP identifies the timeline for each of the actions and tasks identified in the strategy and defines KPIs for monitoring progress towards the strategy objectives and, ultimately towards achieving the overarching vision for the strategy.

2.2.1 Short term Key Priorities

The key priorities for the next 5 years will comprise the following:

- Waste Management Information System operational and data being used to create updated projections & business cases
- Infrastructure roll-out for treatment of C&I (hazardous) and medical wastes
- Delivering Sewage sludge treatment facilities
- Priority rehabilitation of old dump sites
- Phase out illegal dumping and move towards engineered landfill
- Implementation of segregated collection services from households and commercial properties and infrastructure site planning for recyclables
- Raising public & waste producer awareness
- Educating and building capacity of the sector / workforce
- Develop an investment climate (new business models)
- Infrastructure site planning and design work complete for AD and MRFs.

The five components of the waste strategy are all interdependent and thus progress in one component will by definition, affect progress in other components.

2.2.2 Cross Cutting Aspects

In order for the implementation of the strategy to be effective and sustainable there are a number of cross cutting themes that will also need to be highly effective and efficient, specifically:

- Establishment of a Project Management Unit
 - to 'co-ordinate' & facilitate; to monitor & report
- Effective and Robust Regulation & Enforcement
 - clear standards & effective action

- Robust Data upon which to analyse and base decisions
 - better coverage & quality; plus a new Waste Management Information System
- Appropriate, Effective & Sustainable Engagement & Communications
 - awareness raising; schools & university education (and training); and industrial producers engagement

2.2.3 The required 'Journey'

In order to move the current systems away from current practices to adopt more international best practice with the sectors there will need to be a significant number of projects and tasks undertaken, Figure 17 below summarises in very simplistic terms the 'journey' that will be required in order to deliver the vision set out in the waste management strategy for ArRiyadh.

H1436/G2015 FROM THIS

- Single waste stream collated
- Ad-hoc disposal & dumping
- Health & environmental risk

H1466/G2045

TO THIS:

- **Integrated waste management system in place based on:**
 - Full implementation of waste hierarchy
 - Multiple waste streams collated
 - Effective infrastructure and services in place
 - Established markets for recyclables
 - Effective monitoring and review systems
 - Appropriate regulation and enforcement
 - Health and environmental risk limited
- **On the path to the achieving a more 'circular economy'**

30 years



Comprehensive Waste Management Strategy for ArRiyadh City

Executive Summary

January 2016

