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A Review of General Policies and Regulations of Solid Waste Management in Saudi Arabia

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Abstract

Municipal or household solid wastes are generated from several sources in Saudi Arabia and more than 80% of population is concentered in different urban areas and solid waste generation in three largest cities in Saudi Arabia such as Riyadh, Jeddah and Dammam where variable human activities are encountered. Wastes from different generated sources have different physical characteristics depending on their sources. The production of municipal solid waste (MSW) is annually and increasing rapidly as a result of population growth, global urbanization, rapid industrialization and economic development. In Saudi Arabia, the collection services of MSW are facing an increasing number of problems such population growth increasing, changes in habits and lack of awareness of the impact of solid waste on the environment. The increasing in the quantity and types of municipal solid waste in Saudi Arabia is related to multifaceted problem for municipalities in regions and governorates. According to Solid Waste Management System, The Ministry of Municipality and Rural Affairs added some of legislations and laws policy to manage the solid waste handling with scoping objectives to progress the management of municipal solid waste depending on the type of application of waste management in different articles to serve the economically processing of solid waste handling in Saudi Arabia.

Keywords: Municipal or Household Solid Wastes; Heterogeneous Wastes; Waste Management; Legislations and Laws Policy; Natural Resource Consumption; Anthropogenic Greenhouse Gas; Sorting and Recycling

Introduction

The Kingdom of Saudi Arabia (KSA) is located in the South Western Asia, encompassing Red Sea at west to the Arabian Gulf at east and lies at 16° 22', 32° 14 N and 34° 29', 55° 40' E longitudes. The country dwells a population of 30.8 million according to World Bank data [1]. The KSA witnesses a rapid population growth, industrialization and urbanization in the last few decades, resulting in the production of a huge amount of solid waste [2].

The generation rate of solid waste is increasing around the world related to increasing of population growth, changing lifestyles of modern societies and increasing of using of hard-to-decompose materials. In 2016, the average of municipal waste generation rate was 0.74 kg/capita-day which is expected to be 1.26 kg/capita-day by 2050 [3]. The municipalities are facing challenges in providing high level service (LOS) to the public at low rate of life cost such as integrated waste management and zero waste management. The management of municipal solid waste (MSWM) need to improve the performance of their key components, including public service and participation (PSP), personnel adequacy and wellbeing (PAW) [4-6], environmental endurance (ENE) [7,8], physical assets efficacy (PAE) [4,8], operational reliability (OPR) [5,6,8], sustainability compliance (SSC) [8], and economic and financial viability (EFV) [5]. The efficiency improving of MSWM has been recognized as one of the primary objectives in recent sustainable development declarations, e.g., The vision of Kingdom of Saudi Arabia (KSA) for 2030 in gulf countries, they need serious efforts to achieve sustainability of MSWM systems and to assess their existing performance with well-structured of solid waste management in a adequate performance modeling in management of sustainable waste handling [9,10].

Solid Waste Management

The meaning of Municipal Solid Waste is all the materials that are discarded or disposed of, and that is not of use to its product; such as household waste, construction and demolition waste, commercial, administrative, industrial waste, green waste and health

care waste without including of hazardous industrial waste, or waste Dangerous health care. More than 80% of population is concentered in different urban areas and the solid wastes generation in three largest cities in Saudi Municipal or household solid wastes are often are generated from many sources in Saudi Arabia such as Riyadh, Jeddah and Dammam where variable human activities are encountered. In related to several studies in municipal solid wastes from developing countries are generated from households (55–80%) but in Saudi Arabia the waste generated is around more than 15 million tons per year as estimated from 1.5-1.8kg person per day [11-13].

The physical characteristics of municipal solid waste depends on different their sources; such as plastics, papers, metals, leather, food waste, wood, rubbers, inert materials, batteries, paint containers, textiles, construction and demolishing materials and many others which would be difficult to classify [14]. Sorting and separation of waste is one of the fractionation methods and fundamental steps in an integrated waste management system with the potential to provide data on waste generation and the quality of the fractions [15].

The management of municipal solid waste (MSWM) are becoming more complex in many countries, with movement from landfill-based systems to resource-recovery-based solutions [16]. According to a recent estimating in greenhouse gases emission from solid waste which is produced 4.1% of the total GHG emissions and of course cause a big problem in the management and final disposal [17]. The solid waste collection in Saudi Arabia such as garbage which is collected from different individual areas in bin containers and disposed into landfills or dumpsites also the management in Saudi Arabia is lack of good waste disposal facilities and most of landfills are expected to full their capacities within 10 years. Although the importance of recycling, reuse and energy recovery in our life as good income minimizing waste production but it still under activation in both formal and informal sectors. Recycling rate ranges from 10-15%, mainly due to the presence of the informal sector which extracts paper, metals and plastics from municipal waste [17,18].

In sustainability community the 3Rs (reduce, reuse, and recycle) approach of solid waste management as source reduction, reuse, and recycling, is mitigating of MSW discharge [19-21]. The house solid waste (HSW) are examined through different many studies in different source generation and physical waste composition which analyzed to identify the waste generation rate and the potential for using recyclable wastes [22-24]. Some studies described there are correlations between household solid waste quantities and characteristics and relevant socioeconomic factors [25-27]. The generation of municipal solid waste (MSW) plays an important role as indicator to the right choice of solid waste management (SWM) and helping in describing in good modeling which is used for planning and management of MSW [28-30].

In developing countries the authorities of solid waste management are usually the responsible agencies for the processing starting from the collection methodto final disposal with the consideration of sorting and recycling of solid waste which is still lack in Saudi Arabia and the Saudi Arabia system still depending on dumping of final disposal into landfill. The volume of municipalsolid waste (MSW) produced annually is increasing rapidly asa result of population growth, global urbanization, rapid in detribalization and economic development [6]. Also, in the developing countries the waste disposal is still largely random and uncontrolled on other hand the different cities of Saudi Arabia Kingdom the municipal solid waste (MSW) collection services are facing number ofproblems such increasing population growth, changes in habitsand lack of awareness of the impact of solid waste on theenvironment.So that it leads to the high generation of solid waste. The country's population was estimated at 16.1 million in 1992, which is increased to 27.1 in 2010 [2,31]. As according to Global Media Insight the population of Saudi Arabia per years in Figure 1.

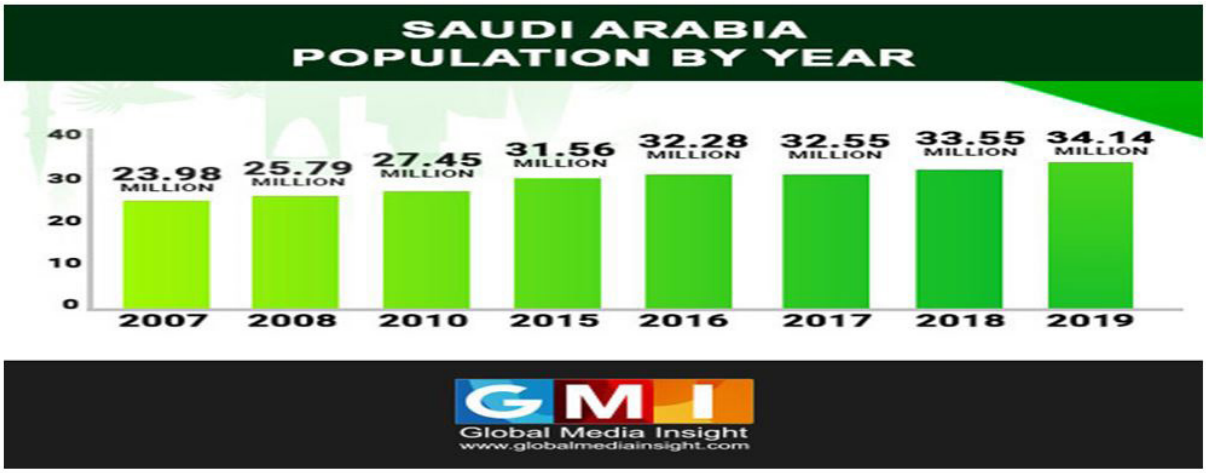

Figure 1: The Population Rating by year in Saudi Arabia

The subject of treating solid wastes is one the most importantissues that were adopted by the League of Arabian Countries inits programs for the year 2008. The league urges researchers' toprepare project proposals for solid waste management at acountry level for the Arab region.

In Figure 2 In Saudi Arabia cities such as in Riyadh, Jeddah, Makkah, Madinah, Al-Taif, Dammam Al-and Hassathe sustainable development goals ofsolid waste management are related tothe local and sustainable communities, consumptionand production, representing a 12% contribution to the achievement of the goals of sustainable development. The management is related to 3 indicators concerning airquality, mentioned in the Environmental Performance Index, protection of land and species [32,33]. There is no doubt that the municipal solid

waste production represents importance in the Kingdom because it requires a sustainable management to preserve human health, resources, environment and economy also, the new municipal solid waste management Law and Regulations contain many environmental, economic, social and health benefits as it is considered a source of raw materials, recycling methods and recovery for energy [34,35].

Figure 2: The main cities in Saudi Arabia Kingdom

The increasing of quantity and types of municipal solid wastes in Saudi Arabia is a multifacetedproblem for municipalities in regions and governorates beside that the increasing in population, leads to increasing of consumption rate and increasing of its production which cause the changing and that needs to raise the development of health careand sanitation services in cities. Municipal Solid Waste Management Law and Regulation is considered as vital management to solveany problems which are related to municipalsolid waste complicated in the Kingdom. The succession of integratedsolid waste management requires raising the community'sawareness of the need to reduce waste production and allow the sorting from the sourceto control of waste production as well as sorting and recycling it. In Saudi Organizations the preparationof specifications of imported and produced materialsis absolutely necessary to reduce waste, quantitatively and qualitatively in order to avoid thecirculation of cheap, low-life goods, which are hazardous to humans and the environment [36,37]. Also, the increasing ofsolid waste is related to introducing of health care services in the Kingdom which has harmful impacts on humans and the environment so that the management Law and Regulation control on the mitigation of health care waste risks, which may dumping into landfill without any treatment, and of course leading to pollution of soil and groundwater. The Solid waste management in the Kingdomis a participatory process that is built on unifying efforts toprotect human health and the environment through supporting of legislation,community awareness, economic support, sound institutional structure, and modern technologies that provide an integratedwaste management, from production until disposal [38].

The solid waste management in Saudi Arabia is considered challenges in most of environmental problems confronting which is related to increasing of solid waste diversity, quantity of solid wastes and effecting on public health, environment andthe economy which is related lackof environmental awareness, the weak consumption culture andthe growing wastefullness of the society, in addition that productionof waste in huge quantities in some locations during short seasons. On beside that inadequate industrial and hazardous waste regulationsto limit waste production, the lack of an integrated waste managementsystem, the absence of a waste sorting from the source, inadequate infrastructure to manage the wastethe lack of documented data on waste quantities, types andcharacteristics, all these pose a challenge to their wise and seriousmanagement. Sorting and recycling of the waste is a vital investment opportunity that strengthens the nationaleconomy, it helps create industries for domestic consumption, and avails jobs opportunities and preserve the environment. It is so imperative to manage solid wastes byapplying safe and appropriate treatment techniques to serve good management in Saudi Arabia As regarding to growing of electronic waste, it has been highlightedthat it poses a threat to the health and environment due to itshazardous compounds. There is an urgent need to develop a system or legislation onhow to deal with electronic waste, find new centers for collectionand recycling, and compel all the electronics manufacturers' oragents to develop recycling programs. The solid waste recycling is considered an investment and good opportunity that requiressupporting legislation and regulatory mechanisms, such as theprovision of concessional loans to encourage the private sectorto expand into an advanced industry to recover the resourcesand protect them from unfair competition. In addition that the necessity of waste sorting and recycling helps increase the economic value, the efficient treatment, energy extraction, conversion ofwaste into organic fertilizers [39-41].

The government of Saudi Arabia aware the management of solid waste is considered a big problem because with increasing of population area meet increasing in waste production and difficult to disposal the total solid waste. So in 2017 they put national budget allocated SR 54 billion for the municipal services sector, which includes water drainage and waste disposal and the Saudi government is making concerted efforts to improve recycling and waste disposal activities and of course the Ministry of Municipal and Rural Affairs will be responsible for overseeing the tasks and responsibilities of the solid waste management system [42,43].

Policies and Legislations of Solid Waste Handling in Saudi Arabia

The General Authority for Meteorology and Environmental Protection (GAMEP) Kingdom of Saudi Arabia the State of the Environment 2017 [44].

According to Municipal Solid Waste Management System in Saudi Arabia, the ministry of Municipal and Rural Affairs added some of legislationsand laws policies to manage the solid waste handling with scoping objectives to progress municipal solid waste management depending on the type of application of waste management in different articles to serve the economically processing of solid waste handling in Saudi Arabia which is managed in the following as articles and it will take through the required regulations and legislations it will take the system which applies to all operations related to the collection, transportation, sorting, recycling, treatment and final disposal of municipal solid waste (MSW):

Article no 2

These General Environmental Regulations and Its Rules for Implementation are aimed to achieve the following:
1. Preserve, protect and develop the environment and prevent its pollution.
2. Protect public health from activities and acts that harm the environment.
3. Conserve and develop natural resources and rationalize their use.
4. Include environmental planning as an integral part of overall development planning in all industrial, agricultural, architectural and other fields.
5. Raise awareness in environmental issues and strengthen individual and collective feelings of responsibility for preserving and improving the environment and encouraging national voluntary efforts in this field.

Article no 3

All the competent authorities which have linking in municipal solid waste management system such as the secretariats, municipalities, and municipal councils which is related to ministries and government institutions related to the system that is control on different types of wastes and have plans how to manage the different types of waste such as commercial and administrative waste which are generated from shops, markets, commercial centers, restaurants, shopping centers, entertainment centers, hotels, and all administrative establishments, such as: schools, universities, ministries, and various administrative offices but green waste is produced waste from public and private gardens and parks, and it comes from green areas, weeds and trees, and those resulting from pruning and maintenance work. In other hand there are different types of waste such as industrial hazardous waste which is generated from industrial activities that may contain solvents, degreasing materials, oils, radioactive materials, coloring materials (inks), dough deposits (sludge), acids and alkalis, materials or waste Industrial other than MSW.

For sorting and recycling of solid waste it should be has known management from collection points by trucks and the mechanisms designated for that then transport by approved means of transportation to transitional stations, sorting and treatment facilities, or sanitary landfills. The sorting or separation in a storage area the components of municipal solid waste from each other, such as: paper, glass, minerals, and other components in transitional stations, or sorting and treatment facilities, with the intention of recycling or treating them after that the recycling of solid waste for recovery or reuse of raw materials in manufacturing operations and transport to final disposal. The treatment stage is the treatment process which is a change in the characteristics of municipal solid waste after sorting it, in order to reduce its volume, or to facilitate its handling when it is reused, or recycled then final disposal for depositing municipal solid waste - which cannot be used, or recycled - in sanitary landfills which is prepared to bur final waste according to the approved technical standards, to get rid of its harmful effects on public health and the environment.

The Ministry undertakes the tasks and responsibilities of managing municipal solid waste, and these tasks and responsibilities include, without limitation, the following:

1 - Raising the health level, safety and comfort of the population in the cities and villages of the Kingdom, by providing services and managing municipal solid waste.
2- Preparing the national strategy for managing municipal solid waste as a framework for institutional and technical work, and raising that according to the regular procedures.
3 - Organizing the implementation of city cleaning projects and managing municipal solid waste, in a way that achieves the public interest, and taking care of city and village hygiene and environmental safety.
4 - Studying and identifying the different requirements and needs, setting the necessary programs and plans and developing them to manage municipal solid waste and following up the implementation of its projects.

5 - Building capacity and developing the relevant departments in the municipalities and municipalities, providing them with information and setting training programs for their employees.
6 - Determining the establishments, buildings or places whose waste collection services are the responsibility of the owner or the beneficiary directly.
7 - Laying down the engineering controls necessary for establishing sanitary landfills to get rid of municipal solid waste, and ensuring that these landfills are in conformity with the conditions and specifications approved by law, and that they are managed, operated, and evaluated, according to internationally approved technical and environmental methods and standards.
8 - Authorizing the burning activity to proceed, in light of the environmental specifications, conditions and controls.
9 - Raising environmental awareness, and preparing and implementing appropriate programs to educate the population on the importance of maintaining hygiene and public health, reducing waste production, and adhering to special instructions when dealing with municipal solid waste.
10 - Setting an emergency plan in coordination with the relevant authorities, secretariats and municipalities to start solid waste management activity in cases of necessity or exceptional circumstances.
11 - Suggesting studies, adopting the implementation of pioneering projects in the field of municipal solid waste management, proposing development projects and the necessary adjustments to the system - to ensure keeping pace with the continuous progress in its management methods - and setting a national database for it.
12 - Study the various alternatives to finance municipal solid waste management, in a way that achieves financial sustainability.
13 - Determine the shelf life of sanitary landfills, the manner of their maintenance and closure, and the future use of landfill land and facilities.
14 - Establish the necessary controls and requirements in coordination with the relevant authorities, to export municipal solid waste.
15 - Develop a plan with the competent authorities to reduce dispersions.
16 - Determine the sites for waste containers, with a mechanism for sorting the waste to be recycled that cannot be recovered.
17 - Encouraging the private sector to practice the municipal solid waste management activity.
18 - Licensing to the private sector to engage in any activity within the municipal solid waste management operations, and the bylaw specifies the licensing terms and controls.

Article no 4

In this article is the all public agencies must take appropriate actions to apply the rules set forth herein for their projects or projects under their supervision or licensing and ensure commitment to environmental regulations, criteria and standards stated in the rules for implementation hereof. Also, the public agencies responsible for the issuance of standards, specifications or rules related to the practice of activities impacting the environment must coordinate with the competent agency before itsissuance.

Article no 5

Responsibilities of the MSW producer:

The Municipal Solid Waste producer shall adhere to the instructions of the Ministry and the competent bodies related to the regulation of Municipal Solid Waste Management operations,

In particular, the obligation to:

1 - Carry out the usual care to reduce the waste produced to the lowest level possible.
2 - Carry out the usual care to reuse and recycle the produced waste to the highest level possible.
3 - Putting the municipal solid waste inside the allocated containers without causing harm to others, and abiding by the regulations issued in this regard.
4 - Adherence to the regulations governing the use of municipal waste containers issued in this regard to not accumulate the municipal solid waste, collect it, store it, or dispose of it in a way that causes harm to the environment, public health or others, or violate the regulations issued in this regard.
5 - Not to put hazardous health care waste, industrial hazardous waste, and dead animals, or their remains, in municipal solid waste containers.
6 - Putting waste of large size in the places specified by the competent authorities.
7 - Putting green waste in plastic bags to prevent the leakage of liquids, link them well, and transport them to the places determined by the competent agencies.
8 - Putting the waste to be recycled - after separation and sorting - in the prepared containers, and placing the waste that cannot be recovered in the other containers.
9 - Maintaining the cleanliness of the area surrounding his residence, facility, or building that he owns, leases, uses, or manages and operates.
10 - Not to dump solid municipal waste in torrential streams and valleys, or underground wells, or on beaches, or in sewage networks or rainwater drainage networks.

Article no 6

It is prohibited for any person of a certain nature or legal nature to use or allow others to use a land, building, establishment or facility that is owned or disposed of as a site for municipal solid waste disposal; Before conducting the environmental assessment studies, and obtaining the approval of the Ministry or the competent authorities, but as relating to there is a lack of awareness among citizens, as some bodies and individuals dispose of solid materials in certain open areas, which results from unpleasant odors or accumulations of insects and gizzards, which results in the spread of diseases and epidemics and thus It becomes a national problem, so the Kingdom has enacted some environmental laws that guarantee rights, spread cultural awareness among citizens, and work seriously to safely get rid of solid waste in a way that guarantees safety for community members.

Article no 7

Producers of construction and demolition waste are obligated to allocate the necessary containers for this type of waste and transport it to the sites designated for them, or to contract with qualified contractors to transport it, in order for the Ministry of Environment to ensure that solid waste does not accumulate in the streets and squares, which leads to difficulty in movement and also causes harm to the surrounding environment and the damage occurs Here, people have to, which causes the spread of stray animals and insects, so the waste must be transported firstly to the places designated for that by specific vehicles and in agreement with specialized contractors. This work is done so that the places are clean and free from accumulations of waste in a large random manner and the places become more civilized.

Article no 8

Ownership of municipal solid waste is transferred to the Ministry for disposal or it is transferred to the competent authorities, where containers designed and designated for collecting municipal solid waste are placed in sites known as solid waste collection places to facilitate their collection and transfer to the final. This will only be done through the work of contracts concluded through the ministry with contractors specialized in this work, or for the ministry to transfer solid waste to a safety of temporary collection, sorting and disposing of it in a scientific and safe manner according to all waste separately and this is done through a specialized program supervised by the ministry directly There shall be penalties for everyone who falls short or lazy in a way that causes harm and damage to the environment and also the information is updated so that the Ministry can deal with the large increase in solid waste according to the increase in population. Spread of insects, traces, and endemic diseases

Article no 9

Any person of a legal nature is prohibited from collecting, transporting, storing, burning, taking, treating, recycling and utilizing municipal solid waste, with the exception of those authorized to do so by the system in order to avoid societal and environmental problems where there are specific collection places, especially for solid waste, and also to transport it safely in cars and private vehicles which does not cause any harm or harm to the citizens or the environment around them.

Article no 10

The Ministry and the competent authorities contract with the contractors who are authorized by law to practice the activity of municipal solid waste management.

Article no 11

The Ministry is the authority competent to contract with the contractor or contractors to work at the national level, or in the case of a contract that covers more than one region, and the competent bodies are the competent authorities to contract with contractors within the boundaries of the administrative region, and the regulations specify the conditions, controls and standards necessary for that in accordance with this system and regulations The other.

Article no 12

The Ministry and the competent agencies in according to what is required by the public interest and the applicable systems, studies and economic standards - partition the projects of municipal solid waste management, either in terms of location or in terms of the type of work, and they may also contract with more than one contractor to implement these projects, and this does not prevent It is contracting with one contractor to carry out all these projects in remote areas, or those where the amount of waste produced does not require contracting with more than one contractor. Article Thirteen: The Ministry allocates - in coordination with the competent agencies and relevant authorities - the sites of land appropriate for the construction of health burials, in accordance with the regulations in force, and scientific and technical controls for the construction of health burials, which are specified in the regulations.

Article no 13

The Ministry and the competent authorities may contract with specialized consulting offices to control and supervise the work of municipal solid waste management, which is authorized by the licensed contractors by system.

Article no 14

Thecompetent authorities may make restoration, demolition, maintenance or settlement contracts or renew them with contracts concluded by the applicant with the contractor to transfer the produced waste to the places designated for this, such as transporting solid waste to final disposal places such as incineration or burning, and this is done routinely within the Kingdom, knowing that there A program for recycling solid waste, but not activated due to some obstacles that refer to activating the program due to the presence of places for incineration and disposal, as well as the lack of specialized labor for this, but the Kingdom takes into account the activation of the program because it is considered a national gain and income that must be taken seriously.

Article no 15

All Sorting, recycling and treatment facilities of municipal solid waste should be undertaken license - abide by the conditions and controls determined by the regulations.

The Strategy Framework of Solid Waste Management

The new Community Waste Management System (CWMS) which applied in some cities in Saudi Arabia to manage the waste handling by new policies for examplein Riyadh City which is represent an excellent opportunity in development of integration approach to manage the City's waste,, service and infrastructure options availableand the priorities of stakeholders. It also appreciate the new waste collection services andinfrastructure of waste management system is developed through undertaken of a suitable a strategy of the regulations and financial aspects plans to determine the success or failure to solve all problems of waste management. And so, the objective offramework strategy is recognizing the effect of good progressing on waste management system in each component which described below:

Governance and Institutions

In relating to the processing and decision-makingforimplementing the waste strategy The Governance will set undertakenrules, sustained and regulated actions to determine responsibilities and accountability betweenagencies and different municipalities. So that The objectives identified for Governance and Institutions are aimed atdriving the strategy's implementation and ensuring change from current practice such as improving enforcement of regulatory requirements; and, encouraging participation from private sector, including PublicPrivate Partnership approaches. Additionally, updating the waste classificationsystem and gathering more detailed data will be a key requirement going forward.

Collection and Recycling

The collection and recycling cover all the processing starting from waste production at sources to appropriate management through the creation of a comprehensive and efficient waste collection services for all sectors and it will be though establishing appropriate separated recycling systemsand markets for each waste sector and material. Another key aspect will be theintroduction of waste prevention and reuse programs.

Treatment and Disposal

The framework strategy of solid waste management contains components which aim to plan to plan and developappropriate treatment and disposal capacity for all waste streams. This will done through using of a phased approach with upgrading of design and operation practice with responding to national environmental standards and international best practice as an interim measure until the new facilities are complete.The component of strategy also covers improving current operational management andrehabilitation of illegal/existing/closed waste disposal sites. These components will also led to diverting waste from dumping and landfilling to recovering through sorting and recycling through appropriate application of waste treatment technologies

Financing and Cost recovery

All Cities of Saudi Arabia need to develop sustainable waste management budget system and moving toward a full cost recovery system management services and it will require harmonizing the financing of waste management system with development policies to ensure waste management services financed and budget in a consistent way and identification of secure sources which needed to invest in future such as promotion and establishment of markets for every aspect of waste management, e.g. recycles, commercial collections and treatment facilities.

Public awareness and Professional development

The implementation of waste strategy is raising public awareness such as waste sorting and recycling, including contributing of the residents in sorting and recycling, reuse, reduction and using new collection schemes not only but also increasing of professional development of waste industry that can be done through introduction of waste aspects in all educational levels from schools to University level. As well as the public, thinking of waste business, through adopting and sharing best practice. The processing of consultation, discussion and analysis, a series of Objectives hasbeen developed for each Strategy Component. The objectives of this strategy have been set for the Short Term (2016 – 2020) and for the Long Term (2021 – 2046).

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 in Tables 1 and 2

Table 1: Strategy components and associated short term objectives 2015-2020

Component Short Term Objectives	Component Short Term Objectives
Governance and institutions	1.Appropriate management and co-ordination to actively 'Drive' delivery of 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 minimization programs, 7. Establish reuse facilitation mechanisms to foster material reuse amongst businesses, industry and institutions.
Collection and recycling	1. Extend waste collection service coverage for all priority waste streams, 2. Improve waste collection services and implement separate collection ofrecyclables. 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 and disposal	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 arising, 5. Delivering appropriate waste management solutions for other waste streams
Financing and cost recovery	1. Set cost-recovery policy targets for solid waste management (SWM) streamsover 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 and professional development	1. Establish public awareness and education program for all cities, 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 2: Strategy components and associated long term objectives 2020-2045

Component Short Term Objectives	Component long-term Objectives
Governance & institutions	1. Unified information on waste management, 2. Management of illegal dumping, 3. Achieve greater transparency and accountability, 4. Enhance government and private sector co-operation 5. 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.
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 implementationphase, 2. Continue to build public awareness and education program, 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.

Conclusion and Recommendations

Solid waste such as municipal and household are generated from several sources in Saudi Arabia and more than 80% of population is concentered in different urban areas and solid waste generation in three largest cities in Saudi Arabia such as Riyadh, Jeddah and Dammam. Sometimes solid waste management of about 10-30% of generated waste is followed by market areas with variation of waste quantities such as streets, industries, institutions among others. The waste sector produced 4.1% of the total GHG emissions and recycling rate is ranged 10-15%, due to the presence of the informal sector which extracts paper, metals and plastics from municipal waste. The presence of laws and

regulations in management of municipal solid wastes will control on economically, socially and health benefits. Saudi Arabia added some of legislations and laws policies to manage the solid waste handling depending on type of application waste management as in different articles to serve it economically.

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