

Technical Guide on Auditing Waste Management

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Board of Internal Audit and Management Accounting
The Institute of Chartered Accountants of India
(Set up by an Act of Parliament)
New Delhi

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Foreword

Addressing the nation in the first episode of Mann Ki Baat of 2023, Hon'ble Prime Minister of India while talking about e-waste management and its ill effects on the environment, said "*If E-Waste is not disposed of properly, it can also harm our environment. But, if it is done carefully, it can become a great force for the Circular Economy of Recycle and Reuse,*"

Waste management is a major challenge for many countries, especially developing ones. Some of the common waste management practices are collection, transport, treatment, and disposal of waste, along with monitoring and regulation of the waste management process and waste-related laws, technologies, and economic mechanisms. However, post pandemic where sustainability is top priority, a more appropriate approach to waste management is based on the 7 R's: Rethink, Refuse, Reduce, Reuse, Recycle, Regulate, and Research. Waste management is a national priority and Chartered Accountants can play an important role by identifying the shortcomings of the waste management system and the responsible factors thereof and suggest measures to improve it.

Waste management has been given more attention by international and national policy makers. As partner in nation building and as one of the ambassadors for Swachh Bharat Abhiyan, the ICAI cannot left behind in advocating for best practices and innovations in this field.

My compliments to CA. Rajendra Kumar P, Chairman; CA. Charanjot Singh Nanda, Vice Chairman and all other members of Board of Internal Audit and Management Accounting (BIA&MA) of ICAI on issuing *Technical Guide on Auditing Waste Management*. This Technical Guide comprehensively deals with the peculiar aspects of Waste Management Industry, including various regulatory aspects and provides step-wise approach for internal audit.

I am sure that this Technical Guide will assist the members and others in efficiently discharging their responsibilities.

June 21, 2023
New Delhi

CA. Aniket Sunil Talati
President, ICAI

Preface

Waste has always been an enduring problem and its management is difficult. The population is growing, and the economy is developing, amount of solid waste is also increasing. Today is total amount of waste generated annually worldwide (Municipality, Industry, Hazardous Materials) is over 4 billion and municipal waste 2 billion tons. Also, global impact of solid waste is also growing as fast as solid management costs will increase from now to \$205.4 billion annually It will reach about \$375.5 billion in 2025.

This pressure mounts on the government and urban local governments to manage trash more effectively. The complexity, expense, and coordination of waste management have made multistakeholder participation in every phase of the waste stream necessary. This necessitates a comprehensive strategy to waste management. This global issue calls for the attention of auditor in order to help promote the green planet agenda and enhance the environment. Internal Auditor are better positioned to find ways to reduce hauling costs and negotiate for waste and recycling services. Internal auditor are expert in tracking waste management activities in one platform and using a standard set of metrics, makes it easier to share and report information with stakeholders.

In order to provide guidance to internal auditors in carrying out internal audit of entities operating in waste management industry, the Board of Internal Audit and Management of the ICAI had published Technical Guide on Auditing Waste Management in 2013. This Guide is now revised considering circular economy solutions that are embedded in the concept of generating zero waste by the Government through innovations that can utilise discarded material to produce reusable and recyclable products. Further, Guide may cover new topics, such as, Environmental and health risks related to waste, Challenges associated with waste management, Categories of Waste, Evaluation of waste management options, On-Site Waste Treatment & Disposal, International Governance Problems.

At this juncture, we are grateful to CA. Guru Prasad M. and CA. Kaushik Raghunandan for sharing their experience and knowledge in review and revising Technical Guide.

We would like to thank CA. Aniket S. Talati, President, ICAI and CA. Ranjeet Kumar Agarwal, Vice President, ICAI for their continuous support and

encouragement to the initiatives of the Board. We also thank the members of our Board who have always been a significant part of all our endeavours.

We also wish to express my sincere appreciation for CA. Arti Bansal, Secretary, Board of Internal Audit and Management Accounting, ICAI, and her team for their efforts in giving final shape to the publication.

We are sure that this publication would prove to be a useful reference Guide for our members and others concerned.

We will be glad to receive your valuable feedback at biama@icai.in. We also request you to visit our website <https://internalaudit.icai.org/> and share your suggestions and inputs, if any, on internal audit.

CA. Rajendra Kumar P
Chairman
Board of Internal Audit &
Management Accounting

CA. Charanjot Singh Nanda
Vice-Chairman
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June 19, 2023

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Glossary

Airspace	The projected bank cubic yards (BCY) of the landfill to be filled with waste as determined by survey and/or other engineering techniques.
Baler	A machine used to compress recyclables into bundles to reduce volume. Balers are often used for newspaper, plastics, and corrugated cardboard.
Boiler	A device used to absorb the heat released during the combustion process of burning waste. This combustion produces steam that can be sold or converted into electrical power.
Brownfield Development	Abandoned, idled, or under-used industrial and commercial facility where expansion or redevelopment is complicated by real or perceived environmental contamination.
Capping	This is the process of placing the final cover material on the landfill.
Cell	The basic unit by which a landfill is developed. It is the general area where incoming waste is tipped, spread, compacted, and covered.
Closed Site (Landfill)	A landfill that has reached its permitted waste capacity and has been permanently capped and certified as closed by the appropriate state regulatory agency.
Closure	The period of time after a landfill has reached its permitted capacity but before it has received certification of closure from a state regulatory agency. During the closure period, certain activities must be performed to comply with environmental and other regulations (e.g., capping, landscaping, etc.).
Commercial Customer	A segment of the business that is made up of commercial and industrial collection.

Construction and Demolition (C&D)	A waste stream that is primarily received from construction sites. Some examples of C&D waste include, but are not limited to, concrete, rebar, wood, linoleum, and carpet.
Container	Any receptacle used to accumulate waste from residential, commercial, and industrial sites. Containers vary in size and type according to the needs of the customer or restrictions of the community. Containers are also referred to as dumpsters.
Chemical Waste Management (CWM)	The operating name of Waste Management's hazardous waste landfills.
Central Pollution Control Board (CPCB)	The Central Pollution Control Board (CPCB) constituted under Subsection (1) of Section 3 of the Water (Prevention and Control of Pollution) Act, 1974 (6 of 1974).
Daily Cover	Material, usually soil that is used in a landfill to cover the refuse after it has been compacted at the end of each day. The cover is placed mainly to ward off animals and for Odur control.
Disposal Fee	A fee charged for the amount of waste disposed of by customers at a landfill. (Also see Tipping Fee)
Drop-off Box or Centre	An area or facility for receiving compostable or recyclables that are dropped off by waste generators.
Dumpster	A generic term use for front-loading and rear-load containers
Emission Control Equipment	A category of equipment used at waste-to-energy facilities to meet emission standards and generate reports required by agency regulators.
Gatehouse	A gatehouse is found at a landfill or a transfer station. All incoming vehicles must stop to be processed and weighed, and all outgoing vehicles must stop to be weighed and receive a disposal ticket for charges.
Greenfield	A tract of undeveloped property purchased with the

Development	intention of obtaining necessary permission on which to operate a landfill. This would not include expansions to existing landfills.
Hauling Fee	A fee charged to roll-off customers calculated from the amount of time it takes to pick up their roll-off container or compactor, dispose of the waste and return it to the customer.
Hazardous Waste	A waste that poses substantial or potential threats to public Incineration health or the environment generally exhibiting one or more of these characteristics: ignitable, oxidizing, corrosive, ecotoxic, radioactive, etc. Such wastes arising from industries are called as Industrial Hazardous Waste.
Hopper	The hopper is the part of a garbage truck or compactor where trash is emptied before compaction into the container.
Incineration	An engineered process involving burning or combustion of MSW to thermally degrade waste materials at high temperatures.
Landfill	A modern engineered way to deposit waste into the ground and still protect the environment.
Landfill, Construction & Demolition (C&D)	A landfill that has been permitted by a state regulatory agency to accept Construction and Demolition of waste. This type of landfill must have properties and design features specific to this type of landfilling that have been established by the state regulatory agency.
Landfill, Hazardous Waste	A waste may be considered hazardous if it is ignitable (i.e., burns readily), corrosive, or reactive (e.g., explosive), contains certain amounts of toxic chemicals.
Landfill, Municipal Solid Waste (MSW)	A landfill that has been permitted by a state regulatory agency to accept municipal solid waste. This type of landfilling must have properties and design features specific to this type of landfill that have been established by the state regulatory agency.
Landfill footprint	Parcels of land that are designated and permitted to perform landfilling activities. This would include the

	entrance, staging area, buffer area and the area that will accept waste for disposal (the waste footprint area).
Leachate	The liquid that seeps through solid waste or other medium and has extracts of dissolved or suspended material from it.
Liner	A protective layer, made of soil and/or synthetic materials, installed along the bottom and sides of a landfill to prevent or reduce the flow of leachate into the environment.
Lock-bar	An optional feature of front-load containers. The lock bar allows a customer to lock the container. When the container is emptied, and the container is raised up and over the truck, gravity causes the bar to drop allowing the container to be emptied.
Materials Recovery Facility (MRF)	Line of business where recyclable material is processed, separated, and sold. This is a facility where recyclable materials are sorted and processed for sale. This process includes separating recyclable materials (manually or by machine) according to type and baling or otherwise preparing the separated material for sale. Operating costs and revenues for MRF's are accounted for as a separate line of business.
Methane	An odourless, colourless, flammable, explosive gas, CH ₄ , produced by anaerobically decomposing MSW at landfills.
Methane Gas Plant	A plant where methane gas (generated from decomposing solid waste) is collected and transported to a gas-processing facility at the landfill site. Once processed, the methane gas is sold directly to industrial users or to an Affiliate of WM to use as a fuel to power electricity generators.
Municipal Solid Waste (MSW)	Includes the domestic waste, commercial waste, institutional waste, market waste and other non-residential wastes, street sweepings, silt removed/collected from the surface drains, horticulture waste, construction and demolition (C&D) waste and

	treated bio-medical waste excluding industrial hazardous waste, and e-waste generated in any municipal authority area in either solid or semi-solid form.
Post-closure	The period of time after a landfill is certified as closed by a state regulatory agency, until WM has no further monitoring responsibility. Environmental and other regulations require the owner of the closed landfill to continue monitoring activities and general maintenance of the site for a specific period of time
Solid Waste	"Regular" garbage from non-industrial sources, such as residential homes, restaurants, retail centres, and office buildings. Typical MSW includes paper, discarded food items, and other general discards. Green waste is considered MSW and includes yard clippings, leaves, trees, etc
Special Waste	Refers to items that require special or separate handling, such as household hazardous wastes, bulky wastes, tires, and used oil.
Transfer Station	A permanent facility where waste materials are taken from smaller collection vehicles and placed in larger vehicles for transport, including truck trailers, railroad cars, or barges. Recycling and some processing may also take place at transfer stations.
Turbine Generator	Device that converts the heat energy of the steam from the boiler into electrical power.
Waste Stream	Specific types of waste found in customer's disposal (trash, cardboard, aluminium, metal, etc.) or a more broad definition of disposal type.
Waste-to-Energy Plant	The WM waste-to-energy facilities consist of large incinerator-type operations where trash is incinerated (burned). The heat from this combustion process is converted into high-pressure steam, which can be used to generate electricity for sale to public utility companies under long-term contracts. The residue from the incineration process is disposed of in a Landfill.

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Chapter 1

Introduction

1.1 According to Basel Convention “Waste” are materials that are not prime products for which the initial user has no further use in production, transformation or consumption, and which user wants to dispose. Wastes may be generated during the extraction of raw materials, processing of raw materials into intermediate and final products, consumption of final products, and other human activities. Residuals recycled or reused at the place of generation are excluded.

Waste management is the collection, transport, processing, or disposal, managing and monitoring of waste materials generally undertaken to reduce the negative effect on health, environment, and resources.

The process of managing waste is generally undertaken either by the generator of waste or by an entity which is engaged in the business of providing service by collecting the waste and disposing of the waste subject to treatment of such waste. Waste managed by the generator is a cost to the generator and waste managed by service provider is an income to the service provider.

1.2 Waste management practice may differ for developed and developing countries, for urban and rural areas and for residential and industrial producers. Management of non-hazardous residential and institutional waste is usually the responsibility of the local government. Management of non-hazardous commercial and industrial waste is the responsibility of the generator subject to local, national, or international laws & restrictions.

Depending on the physical state of waste, wastes are categorized into solid, liquid, and gaseous. Solid wastes are further categorized into municipal wastes, hazardous wastes, medical wastes, and radioactive wastes. Managing solid waste generally involves planning, financing, construction, and operation of facilities for the collection, transportation, recycling and final disposition of the waste.

Objective and Scope of Technical Guide

1.3 This technical guide is intended to assist Internal Auditors in carrying out internal audit of entities operating in the waste management/ generating

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industry. The management in concurrence with the internal auditor with the various pronouncements of ICAI and other regulatory requirements, assessment of control environment and business domain knowledge primarily decides the scope of the internal audit. The technical guide deals with various areas of entities operating in this Industry with emphasis on compliance as mandated by various applicable laws and regulations.

This Technical Guide has been divided into following parts:

- Part I Glossary.
- Part II Elaborates the scenario in the Indian Waste Management Industry and challenges faced by an entity operating in this Sector.
- Part II Segments in Waste Management Industry and Disposal Methods.
- Part IV Laws and Regulations in India regarding Waste Management Industry.
- Part V Industry wise analysis.
- Part VI Risks and Challenges for Industry.
- Part VII Need for Internal Audit.
- Part VIII Appendix.

1.4 This technical guide does not cover the following aspects covered by other publications and pronouncements by ICAI and which are of specialised nature and non-operational in essence:

- (i) Internal audit of routine operations in finance and other areas/ functions of business.
- (ii) Internal audit performed by the associated enterprises.
- (iii) Special audits.
- (iv) Forensic Accounting and Investigations.

Chapter 2

General Understanding of Waste Management Industry

2.1 The term “Waste” refers to materials that are not prime products (i.e., products produced for the market) for which the generator has no further use for production, transformation, or consumption and which he discards. Wastes may be generated during the extraction of raw materials, during the processing of raw materials to intermediate and final products, during the consumption of final products, or during any other such processing activity.

The following are excluded from the term waste:

- Residuals directly recycled or reused at the place of generation.
- Waste materials that are directly discharged into ambient water or air.

In other words, waste includes all items that people no longer have any use for, which they either intend to get rid of or have already discarded. Wastes are such items which people are required to discard by law because of their hazardous properties.

Waste originates from many sources, not only from households but also from industry and commerce.

Types of Waste

2.2 Wastes generated from different sources can be classified as per their origin and nature as follows:

- Plastic Waste
- E-Waste
- Construction & Demolition Waste
- Medical Waste
- Industrial Waste
- Hazardous Waste

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Plastic Waste

Plastic Waste refers to the scores of plastics generated after various household and commercial purposes. The unattended plastic waste can proliferate into water sources, soil and can pollute them with its non-dilutable nature. Due to the forces of sunlight and air, plastic waste can be converted into micro plastic and become inseparable.

E-Waste

E-Waste refers to the waste generated out of electronic goods like mobile gadgets, laptops, television sets, etc. E-Waste also includes electronic accessories, like, earphones, mouse, etc. E-waste is typically electronic goods in part or full, which is post its useful life and is to be disposed off. since electronic gadgets have become the essentials of our routine life and their shelf life is generally few years, the challenges posed by E-Wastes are mounting. Since their composition is complex, they have to be treated separately to prevent their negative impact on the environment.

Construction & Demolition Waste

Construction of new buildings and demolition of the old structures are very much part of urbanization. India has been witnessing a rapid urbanization across the country. Since construction and demolition results in lot of dust and wastes in the form of cement and iron structures, they can't be treated like other wastes, since they are less reusable, nor they are degradable. In cities particularly, construction related waste contributes majorly to its air pollution.

Medical and Bio Waste

Medical and Bio wastes are generated primarily from the healthcare sector, in the form of used syringes, expired medicines, used medicine containers, discarded diagnostic samples, swabs, bandages, etc. Since medical wastes are highly infectious, they pose a great degree of threat to the immediate surroundings as well as the society at large.

Industrial Waste

Industrial Waste refers to the waste materials produced during the industrial manufacturing activities. Industrial wastes include chemicals, scrap metals, solvents, dirt and gravel, etc. Industrial Waste can act as an input to some other industrial / productive activities as well (this need not be the case with each industrial waste); hence they have to be segregated carefully so that they don't cause any damage and also to maximise its usefulness.

Hazardous Waste

Hazardous Wastes are the wastes generated out of different sources, but with their nature being harmful to the environment, they are clubbed together and called hazardous wastes. Hazardous wastes can be a product of either industrial processes or any other processes.

Environmental and Health Risks related to Waste

2.3 Hazardous waste may cause long-term contamination of water and soil and severely affect people's health and living conditions. The following are the sources of danger and their impact on environment:

Soil Contamination

2.4 Municipal waste disposal, industrial activities and accidents are common generators of soil pollutions. Hazardous substances may enter into soil from incineration ashes or through leachates, as water trickles through contaminated sites leaching out chemicals. In agricultural areas and feedlot, fertilizers and bacteria enter into the soil. In landfills, cocktails of chemicals may leak into the soil.

Polluted soil can release toxic components into the food chain and also damage flora and fauna directly. Inhaling or touching contaminated soil or eating plants from contaminated soil may have adverse health impacts on human and animals. For humans, contaminants may affect the nervous system, cause mental disorders, cancers and damage the kidney.

Surface and Groundwater

2.5 Surface or rainwater seeping through waste will absorb hazardous components from agricultural area, feedlot, landfills, etc and carry them into surface and groundwater. This may lead to changes in the chemistry of water, with adverse effects on the ecosystem and the food chain. Contamination of surface and groundwater may cause damage to wetlands, and their ability to support healthy ecosystems and control flooding. Contaminants may also enter into the food chain through fish and shellfish and accumulate when eaten by other animals. It also poses a great health risk as it is often used for drinking, bathing and recreation and also in agricultural and industrial activities.

Marine Pollution

2.6 Marine pollution constitutes a large threat to marine life, mangroves, fisheries, coral reefs and coastal zones. Approximately 80% of marine pollution comes from land-based sources, like, pesticides, heavy chemicals, POPs, electronic waste and marine litter. As for marine litter, plastic waste is a growing concern as it spreads across the world's oceans. As plastic material degrades slowly, it may remain drifting in oceans from years to decades. Balance 20% of marine pollution include oil spills, untreated sewage and discharges of oily waste from ships. The emission of untreated sewage is one of the greatest dangers to marine life, and its ability to recover from extreme climatic events.

Air Emissions

2.7 Air emissions are mainly produced by fumes from landfill gases and incineration. Incineration fumes may stem from open burning of hazardous wastes, which still is a widespread practice worldwide. Scavengers at landfills often set fire to the waste to make it easier for them to find metals. Uncontrolled fires in landfills due to self-ignition (often caused by illegal dumping of hazardous waste) are also a major source of emissions to air. Old or badly operated incineration plants can also be a source of hazardous emissions such as heavy metals (mercury, cadmium, etc.) and dioxins. Air pollution may cause health issues such as respiratory problems, as contaminants are absorbed into lungs and human tissue. Some air contaminants may also harm humans and animals when in contact with skin. Plants also are affected by exposure to air contaminants.

Odour and Littering

2.8 Few problems caused by waste are related to nuisance. An example of this is the bad odours that originate from containers or waste left on streets, is one of the reasons why waste must be collected frequently. Waste treatment plants, especially landfill sites, can also be a source of odour problems. During decomposition of methane, carbon dioxide and organic waste a large variety of other gases are released. A landfill can cause loss of amenity and nuisance several kilometres away from where it is located.

While littering often is an aesthetic problem, it may also constitute an environmental risk. While marine litter may carry POP's, littering on land may lead to the blocking drainage pipes and causing environmental problems such as flooding.

Impact of Waste on Environment and Health

2.9 The Global Development Research Centre, GDRC defines Quality of Life (QOL) as the product of the interplay among social, health, economic and environmental conditions which affect human and social development. QOL reflects the gap between the hopes and expectations of a person or population and their present experience.

In a country like India, which aspires to be a global economic giant, public health and quality of life are degrading everyday with the increasing gap between services required and those provided. India is also considered a sacred nation by the majority of its inhabitants but the streets and open lands in Indian cities are filled with untreated and rotting garbage. These untreated waste leads to lots of environmental and health hazard. The production of waste is growing as a by-product of economic growth that has led to a subordinate manner of disposal and dealing with waste under the umbrella law of Environment Protection Act, 1986.

2.10 Disposal of e-wastes is a particular problem faced in many regions across the globe. Computer wastes that are landfilled produces contaminated leachates which eventually pollute the groundwater. Acids and sludge obtained from melting computer chips, if disposed on the ground causes acidification of soil. For example, Guiyu, Hong Kong a thriving area of illegal e-waste recycling is facing acute water shortages due to the contamination of water resources.

This is due to disposal of recycling wastes such as acids, sludges, etc. in rivers. Now water is being transported from faraway towns to cater to the demands of the population. Incineration of e-wastes can emit toxic fumes and gases, thereby polluting the surrounding air. Improperly monitored landfills can cause environmental hazards. Mercury will leach when certain electronic devices, such as circuit breakers are destroyed. The same is true for polychlorinated biphenyls (PCBs) from condensers. When brominated flame retardant plastic or cadmium containing plastics are land filled, both polybrominated diphenyl ethers (PBDE) and cadmium may leach into the soil and groundwater. It has been found that significant amounts of lead ion are dissolved from broken lead containing glass, such as the cone glass of cathode ray tubes, gets mixed with acid waters and are a common occurrence in landfills.

Need for Waste Management

2.11 In order to make the world a better place to live, it is pertinent that the wastes so generated are managed better. Waste management practices can differ for developed and developing nations, for urban and rural areas and for residential and industrial producers. Management for non-hazardous residential and institutional waste in metropolitan areas is usually the responsibility of local Government authorities, while management for non-hazardous commercial and industrial waste is usually the responsibility of the generator subject to local, national or international controls.

Waste management is an invaluable public health service and during the conducive times of the Covid-19 pandemic, it has become a lifesaver. Those of us from the middle class and rich class who are privileged enough to have this service are benefiting from avoiding the health risk of waste piling up. While waste management workers across the world are striving hard to protect their communities; they are at a greater risk to their own health mainly those from the informal sector.

2.12 Waste management is the collection, transport, processing, or disposal, managing and monitoring of waste materials. The term usually relates to materials produced by human activity, and the process is, generally undertaken to reduce their effect on health and environment.

A solid waste management (SWM) system includes the generation of waste, storage, collection, transportation, processing, and final disposal. Agricultural and manufactured products of no more value are discarded as wastes. Once items are discarded as waste, they need to be collected. Waste collection in most parts of the world is centralized and all kinds of waste generated by a household or institution are collected together as mixed wastes.

2.13 Solid waste management (SWM) is a basic public necessity, and this service is provided by respective urban local bodies (ULBs) in India. SWM starts with the collection of solid wastes and ends with their disposal and/or beneficial use. Proper SWM requires separate collection of different wastes, called source separated waste collection. Source separated collection is common in high income regions of the world like Europe, North America, and Japan where the infrastructure to transport separate waste streams exists. Most centralized municipal systems in low-income countries like, India collect solid wastes in a mixed form because source separate collection systems are non-existent. Source separated collection of waste is limited by

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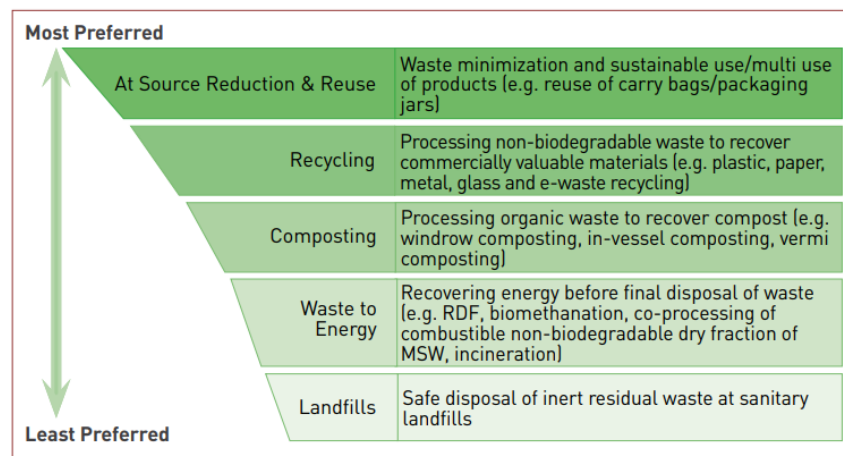
infrastructure, personnel, and public awareness. Indian cities are still struggling to achieve the collection of all MSW generated. Metros and other big cities in India collect between 70- 90% of MSW. Smaller cities and towns collect less than 50%. The benchmark for collection is 100%, which is one of the most important targets for ULBs at present. This is a reason why source separated collection is not yet in the radar.

2.14 Waste management workers/helpers are continuously providing huge variety of services to ensure that all waste is systematically disposed off.

Waste Disposal Mechanism

2.15 The method of waste so generated is categorised into large scale disposal and small-scale disposal. The various method of disposal falling under these categories are Open Dumps, Landfills, Incineration, Composting, Recycling, Reuse, Recovery, etc.

The most favoured and least favoured option of waste management is best expressed in the following picture.



(Source: Swachh Bharath Mission, Municipal Solid Waste Management manual)

Government Initiative and Voluntary Contribution

2.16 The role of Government cannot be understated while discussing waste management, be it solid waste, electronic waste or plastic waste. The government both central and state have together as well as separately introduced various laws for managing the waste.

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Some of the laws introduced are as follows:

- The Environmental (Protection) Act, 1986
- Bio-medical Waste Management Rules, 2016
- E-Waste (Management) Rules, 2022
- Solid Waste Management Rules, 2016 (Amendment)
- Plastic Waste Management Rules, 2022
- The Hazardous and other Wastes (Management & Transboundary Movement) Rules, 2016
- Battery Waste Management Rules, 2022

There are corporates and other entities, including not for profit organisation, making efforts in bringing awareness to the public and also implementing policies internal to their organisation for managing the waste. Though the Government and some entities volunteer to manage waste including spreading awareness, the onus to manage waste is with every individual and/or the entity generating waste. Recent mandate from various ULB's based on the guidance from both central and state government on segregating the waste at source into dry and wet waste is an indication that the onus to manage waste is from the place waste is generated and by the generator of waste.

Statistical Analysis of Waste

2.17 Due to population growth, industrialization, urbanization and economic growth, a trend of significant increase in municipal solid waste (MSW) generation has been recorded worldwide. MSW generation, in terms of kg/capita/day, has shown a positive correlation with economic development at world scale. Due to rapid industrial growth and migration of people from villages to cities, the urban population is increasing rapidly.

Waste generation has been observed to increase annually in proportion to the rise in population and urbanization. The per capita generation of MSW has also increased tremendously with improved lifestyle and social status of the population in urban centres. As more land is needed for the ultimate disposal of these solid wastes, issues related to disposal have become highly challenging.

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2.18 India, with a population of over 1.40 billion accounts for 17.68% of the world population (Data as per the United Nations Population Fund website). According to the United Nations, 34.9 % of Indian Population live in the urban areas of the country. The very high rate of urbanisation coupled with improper planning and poor financial condition has made MSW management in Indian cities a herculean task.

Year	Solid Waste Generation Per Capita (gm/day)
2020-21	119.07
2019-20	119.26
2018-19	121.54
2017-18	98.79
2016-17	132.78
2015-16	118.68

(Source: CPCB)

State	Total Wards	Total Waste Generation (MT/D)
Andaman & Nicobar	24	90
Andhra Pradesh	3409	6141
Assam	943	1432
Arunachal Pradesh	75	181
Bihar	3377	2272
Chandigarh	26	479
Chhattisgarh	3217	1650
Daman & Diu	28	32
Dadar & Nagar Haveli	15	55
Delhi	294	10500
Goa	217	250
Gujrat	1427	10274
Haryana	1496	4783

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State	Total Wards	Total Waste Generation (MT/D)
Himachal Pradesh	497	377
Jammu & Kashmir	1081	1489
Jharkhand	932	2135
Karnataka	6464	10000
Kerala	3536	2696
Madhya Pradesh	7115	6424
Maharashtra	7322	22080
Manipur	306	174
Meghalaya	114	268
Mizoram	264	236
Nagaland	234	461
Odisha	2024	2721
Puducherry	122	415
Punjab	3123	4100
Rajasthan	5389	6500
Sikkim	53	89
Tamil Nadu	12814	15437
Telangana	2112	8634
Tripura	310	450
Uttar Pradesh	12007	15500
Uttarakhand	1170	1589
West Bengal	2938	7700
Total	84475	147613

(Source: MoHUA, 2020)

Waste Management Industry in India – Overview

2.19 Waste collection in India goes back to the 17th century, where bones, rags and paper were among the first commodities to be collected. Solid waste management was traditionally the responsibility of municipal bodies. Across the country, the workforce carrying out solid waste collection and transport activities consisted primarily of socially excluded communities on the margins of society.

Current Structure of the Informal Waste Sector

2.20 Nowadays, large numbers of people are associated with waste management in India. Researchers estimate that about 1% of the urban population in India is active in the informal recycling sector. The informal waste sector is socially stratified in a pyramid with scrap collectors (waste pickers and itinerant waste buyers) at the bottom and re-processors at the top. The majority of retailers are former waste pickers who have managed to assemble some capital and to take up another activity. Scrap collection is the first stage in the recycling sector and is undertaken by two categories of workers: waste pickers and itinerant buyers.

Waste pickers retrieve paper, plastic, metal and glass scrap from garbage bins or receptacles provided by municipalities for the disposal of garbage on the street, and from landfill sites where collected garbage is transported and dumped. They rudimentarily sort and then sell the collected scrap commodities to retail scrap establishments by weight or unit. Itinerant buyers purchase small quantities of scrap from households, offices, shops and other small commercial establishments.

2.21 The retail traders form the top stratum of the scrap trade and are most often located in slums with significant populations of scrap collectors. They have a direct relationship with the scrap collectors from whom they purchase scrap. Processing and reprocessing industries that source scrap usually exist in both the informal and the formal economy. Plastics and electronic waste are typically processed in the informal sector while paper, cardboard, metals, and glass are handled by the formal sector. There are currently 24 officially recognised waste picker organisations in India, with various levels of contractual and non-contractual relations to the formal authorities. They are formed as co-operatives or associations and are integrated in local source segregation schemes at different levels. Their tasks vary from door-to-door garbage collection to the management of recycling centres and scrap trading.

Organisational Developments in the Informal Waste Sector

2.22 Since 1972, efforts have been made by local NGO 's to organise the waste pickers, but the results do not yet extend across India. Due to the predominant role of women in waste picking, women's organisations were the first to throw light on waste pickers and their interests. These early approaches encouraged waste pickers to transfer to work less demeaning to their dignity and less hazardous to their health. The key activities were formation of cooperatives for contract cleaning and housekeeping, collection of wastepaper from government offices and institutions and trade in wastepaper.

In 1990 the Project for the Empowerment of Waste pickers of the Women's University in Pune in Western India started organising waste pickers around their work issues. Amongst other initiatives, the project issued identity cards to waste pickers and promoted source segregation of waste and its door-to-door collection by waste pickers.

In subsequent years waste picker organisations were formed in Delhi, Bangalore and other cities, based on the understanding that waste pickers have a customary right to recyclable scrap and asserting that waste pickers' livelihoods could best be protected and enhanced by promoting source segregation of waste and its door-to-door collection. All of the organisations underscored the value and the work of informal sector waste recyclers.

2.23 The projects had the following principal aims:

- integrate waste pickers into community based, decentralised solid waste management;
- promote the contribution of waste pickers.
- reduction in municipal waste handling costs, resource recovery; environment conservation, recycling and economic productivity;
- improve work conditions and livelihoods of rag pickers rather than transferring waste pickers into other occupations.

Subsequent developments in the following years led to the formation of different waste management initiatives and included engaging in dialogue with waste generators to enable them to understand the relevance of involving waste pickers in emerging waste management initiatives.

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2.24 As a result of their increasing involvement, a National Alliance of Waste Pickers was founded in 2005. The various organisational support efforts collectively led to high levels of integration of informal waste pickers into the solid waste management system in various cities. In Pune, for example, waste pickers have been authorised by the municipality to provide household waste collection, providing them with direct access to recyclables.

In many places, informal sector workers in solid waste management are not part of a regularised business environment, but work autonomously, pursuing several parallel economic activities and are, thus, not regularly active in solid waste collection and recycling. In initiatives to fully integrate informal waste collectors into waste collection enterprises, the drop-out rate was high and waste pickers either lost their income opportunities or returned to individual waste picking activities in poor working conditions. Because of the unsteady nature of informal worker activity in waste management, these workers are sometimes perceived as unreliable service providers for waste collection services.

Informal sector workers can position themselves as regular service providers by organising themselves in co-operatives and other structures able to provide a regular collection service, independent of the workforce of individual informal sector workers. The use of near relatives as replacements for waste pickers who are irregular in their waste collection has been successful in India.

This organisational ability and entrepreneurial capacity are important also in recycling activities, in order to establish regular business relations with the administration and clients in the manufacturing and export sectors. Co-operatives of waste pickers are most durable when they take into account the specific working habits and conditions of waste pickers but nevertheless create a minimally structured environment for reliable business partnership.

Waste Management by Corporates/ NGOs – Case Study

2.25 NGOs often creates crucial links between the formal and the informal private sector. NGOs can provide technical expertise, financial and legal support and advisory services. Due to their humanitarian approach, they work without self-interest for the development of waste pickers and can therefore be trustworthy and accepted as partners. They can reduce distrust between

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the formal and the informal sector and between socially excluded waste pickers and the general public and can thereby serve as arbitrators and process facilitators.

2.26 The SWaCH (Solid Waste Collection and Handling) cooperative of waste pickers and other urban poor was established in 2007 to provide doorstep garbage collection services across the city of Pune. It was designed as a professionally managed service delivery organisation within the broad framework of developing models that are inclusive of the poor. Swachh operates in the area of waste management that includes collection, resource recovery, scrap trading and waste processing. It is, therefore, an autonomous entity but its operations are being financially supported by Pune Municipality (PMC) for a period of five years, during which it is tasked with exploring revenue sources and becoming an independent income-generating entity. The PMC is committed to supporting the management, equipment, infrastructure costs and certain welfare costs during the start-up phase. User fees are to be recovered from service users.

The user fees and income from the sale of recyclables will constitute the earnings of waste pickers. Structurally, the governance arm of Swachh comprises 14 waste pickers/collectors, 2 PMC representatives and 1 representative of the KKPKP cooperative. The management arm of Swachh is headed by a Chief Executive Officer, supported by a team of staff for operations, administration and finance, marketing, customer care and relations, management, information systems and data management. Provision has also been made for technical consultants in areas including citizens' education, management information systems, composting and bio methanation.

2.27 In India, the legal framework is generally enabling in making provisions for incorporating the informal sector in solid waste management. The Indian experience also shows that the legal implementation of informal sector integration is a learning process.

The Municipal Solid Waste (Collection and Handling) Rules were issued in 2000 under a federal act. The rules not only acknowledged the importance of waste segregation and recycling, but also made it obligatory. Yet despite the vital role of the informal sector in the segregation and recycling of solid waste, it was not mentioned in the legislation. Various problems occurred as a result. Waste pickers had to compete with incinerators for waste of high calorific value. Municipalities outsourced door-to-door collection to large

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corporate players, thereby displacing the waste pickers. Ultimately, the Rules failed to link solid waste management policy to existing good practices such as segregation and recycling by informal sector actors.

A few years later, in 2006, a national policy mentioned the informal sector for the first time. The National Environment Policy contained clauses strengthening the capacity of local bodies for segregation recycling and giving legal recognition to informal sector systems.

Challenges Associated with Waste Management

2.28 Challenges associated with Waste Management are as follows:

- Lack of waste segregation
- Lack of waste processing capacity
- Lack of policy implementation
- Inadequacy of finance & investments
- Inability / Viability of technology
- Lack of public awareness and support
- Lack of institutional knowledge

Lack of Waste Segregation at Source

The major challenge posed to Waste Management is the lack of segregation of wastes at their origin or at the first point / place of disposal. When wastes are released without scientific segregation, waste management becomes an extremely uphill task. Industrial wastes released without segregation pollute the waterbodies and their immediate environment. Household waste disposed without segregation makes recycling impossible and medical-bio waste disposed without segregation makes it highly infectious.

Lack of Waste Processing Capacity

India lacks capacity to recycle / scientifically dispose all the waste that is being generated. As a result, waste dumping yards are very much part of the urban waste management by the municipalities. India lacks readily installed infrastructural capacity to recycle the waste into raw materials for some other industries. The capacity addition is yet to take place from towns as small as tier-4 towns to largest metropolitans.

Lack of Policy Implementation

It is not that India lacks sufficient policy and procedural frameworks to tackle the challenges faced in waste management, but there is a serious lack of implementation of those policies and procedures. For e.g., government provides municipalities with vehicles to collect dry waste and wet waste separately, but people are reluctant to segregate the waste. Government has framed rules to levy fines on people throwing garbage in public places, but such fines are hardly levied when compared with the scale of garbage we see in public.

Inadequacy of Finance & Investments

The reasons for shortage in installed capacity to recycle entire waste produced in India can be traced back to the inadequacy of the financial support available to build such infrastructure. Given the large size of the country and the complexities and diversities of wastes and waste management techniques required, financing them is a huge challenge, without putting a burden on the public in large. Though the private investments in this sector are encouraged, their participation has so far been not too encouraging due to various reasons.

Limitations of Technology and its Viability

The mixed waste or unsegregated waste makes it difficult to treat them scientifically aided by the technology. The technology largely in use can only treat specific type of waste, provided that such waste is in a desired form.

Also, even when technology can recycle the waste and converts it into another useable form, it needs to be viable financially. For e.g., if a unit of electricity generated out of waste is costlier than the unit of electricity generated out of hydro power, energy companies tend to buy hydro power-based electricity over the waste generated electricity.

Such technological and financial concerns are a challenge to scale up and widen the process of waste management.

Lack of Public Awareness / Support

No policy initiative can be successful without voluntary public support and participation. This couldn't be truer when it comes to the waste management. Waste management in India, today stands as a failure primarily due to lack of large-scale public participation. Such disinterest in public participation and

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disobedience to the rule's framework works against the very idea of waste management. Disposing waste without segregation, throwing garbage in public spaces are some of the major indications showing that the waste management initiative has not yet been fully backed by the public. Despite the various public awareness initiatives by the government, much of the progress is yet to be made in this regard.

Lack of Institutional Capacity

Apart from the infrastructural capacities to scientifically manage the waste generated, in India institutions responsible for waste management lack the capacity (knowledge as well as expertise) to manage all kinds of waste.

Since in India waste management falls under the purview of local bodies (urban and rural local bodies), most of them lack the knowledge and the sophistication required to handle all types of waste. In India only cities with large population may be in a position to manage all sorts of wastes, since there is a relatively higher availability of resources and access to knowledge, but the same cannot be said with respect to small urban local bodies and rural panchayats.

Even for Public-Private Participation (PPP) model of waste management, the small size of the urban local bodies and rural bodies don't make it commercially viable for the private sector partner to take up waste management on its own.

2.29 Waste generation has a lot to do with the average income of the country (i.e., per capita income). More the income, lesser the biodegradable waste and vice-versa. Our waste management capacity installation has to keep this in mind before setting up waste processing plants.

National PCI	Percentage of Biodegradable waste
<\$1005	>60%
\$1006-\$3955	50% to 60%
\$3956-\$12235	30% to 55%
>\$12236	<30%

(Source: ICRIER)

Chapter 3

Segments in Waste Management Industry

3.1 Waste management industry can be segregated as follows:

- Municipal Solid Waste
- Industrial Waste
- Bio-medical Waste
- Electronic Waste
- Radioactive Waste.

Municipal Solid Waste (MSW)

3.2 Municipal solid waste (MSW), also called Urban Solid Waste, is a waste type that includes predominantly household waste (domestic waste) with sometimes the addition of commercial wastes, construction and demolition debris, sanitation residue, and waste from streets collected by a municipality within a given area. They are in either solid or semi-solid form and generally exclude industrial hazardous wastes. MSW can be broadly categorized into five broad categories as follows:

- (i) Biodegradable waste**– food and kitchen waste, green waste
(Vegetables, flowers, leaves, fruits), paper (can also be recycled).
- (ii) Recyclable material**– paper, glass, bottles, cans, metals, certain plastics, etc.
- (iii) Inert waste**– construction and demolition waste, dirt, rocks, debris.
- (iv) Composite wastes**– waste clothing, tetra packs, waste plastics such as toys.
- (v) Domestic hazardous waste** (also called "household hazardous waste") & **toxic waste**– Medication, e-waste, paints, chemicals, light bulbs, fluorescent tubes, spray cans, fertilizer and pesticide containers, batteries, shoe polish.

Segments in Waste Management Industry

Sources and Type of MSW

3.3 The following are some major sources of MSW:

Sources	Typical waste generators	Components of solid waste
Residential	Single and multifamily dwellings	Food wastes, paper, cardboard, plastics, textiles, glass, metals, ashes, special wastes (bulky items, consumer electronics, batteries, oil, tires) and household hazardous wastes.
Commercial	Stores, hotels, restaurants, markets, office buildings	Paper, cardboard, plastics, wood, food wastes, glass, metals, special wastes, hazardous wastes
Institutional	Schools, government centre, hospitals, prisons	Paper, cardboard, plastics, wood, food wastes, glass, metals, special wastes, hazardous wastes
Municipal services	Street cleaning, landscaping, parks, beaches, recreational areas	Street sweepings, landscape and tree trimmings, general wastes from parks, beaches, and other recreational areas

Comparison between the per capita MSW generation rates in Low, Middle and High Income Countries (on the basis of Income) is as follows:

Country	Per capita urban MSW Generation(kg/day)	
	1999	2025
Low Income Countries	0.45 - 0.9	0.6 - 1.0
Middle Income Countries	0.52 - 1.1	0.8 - 1.5
High Income Countries	1.1 - 5.07	1.1 - 4.5

3.4 Municipal Solid Waste (MSW) collection—is the component of waste management which comprises lifting and removal /passage of a waste material from the source of production to either the point of treatment or final

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disposal. Collection of generated solid waste is the crucial part in MSW management. Efficiency in collecting solid waste and segregating it decides how well solid waste is managed. Collection includes not only the gathering of solid waste, but also the transport of these materials, after collection, to the location where the collection vehicle is emptied. This location may be a material processing facility, a transfer station, or a landfill disposal site.

3.5 Collection of MSW broadly involves following functional elements:

Stage I– Collection from Non-point Source

This stage includes door-to-door collection of waste. Most collection is done by garbage collectors who are employees or firms under contract to the government. Garbage collectors employed by local governing bodies manually collect the waste generated at the household level and dump it in the community bins at specified street corners. Municipality is not responsible for door-to-door collection of waste from houses, offices, small shops, and small markets. Here people are required to deposit their wastes in communal containers/ community bins (stationary or haul types), from which it is collected by municipal crew. The vehicle used in this stage for collection, is small and simple & varies from place to place. It may be two wheeled carts pulled by an individual or bell ringing vehicles (*ghanta gadi*).

Stage II– Collection from Point Source

Waste collected from non–point source is deposited to definite point sources namely communal bins. Communal bins are placed near markets, in apartment complexes, and in other appropriate locations. Shopping complex, hotels, public places like, gardens, religious places are other definite point sources. Vehicles collect's large amount of waste from these point sources and then transport it to transfer stations and disposal sites. Manually or mechanically loaded compactors are often used in this stage. Placing communal bins at appropriate locations for deposit and storage of waste is important to manage waste properly.

For better MSW management garbage should be lifted frequently from these point sources. Frequency in lifting garbage from these points really matters otherwise garbage pile up and create other problems. It is challenging task particularly in metros. In Mumbai 929 Municipal and Private Vehicles are used for collection of waste making around 1600 number of trips each day (2021, A Technical Report on Solid Waste Management of Mumbai, published on the International Journal of the science).

Segments in Waste Management Industry

State	Total Wards	Wards with 100% door-to-door collection
Andaman & Nicobar	24	24
Andhra Pradesh	3409	3409
Assam	943	698
Arunachal Pradesh	75	75
Bihar	3377	3276
Chandigarh	26	26
Chhattisgarh	3217	3217
Daman & Diu	28	28
Delhi	294	294
Goa	217	217
Gujrat	1427	1427
Haryana	1496	1401
Himachal Pradesh	497	490
Karnataka	6464	6464
Kerala	3536	3022
Madhya Pradesh	7115	7115
Maharashtra	7322	6590
Manipur	306	270
Meghalaya	114	27
Mizoram	264	264
Nagaland	234	148
Odisha	2024	2009
Puducherry	122	122
Punjab	3123	3064

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State	Total Wards	Wards with 100% door-to-door collection
Rajasthan	5389	5389
Sikkim	53	53
Tamil Nadu	12814	12429
Telangana	2112	2020
Tripura	310	277
Uttar Pradesh	12007	11872
Uttarakhand	1170	1170
West Bengal	2938	2527
Total	82447	81135

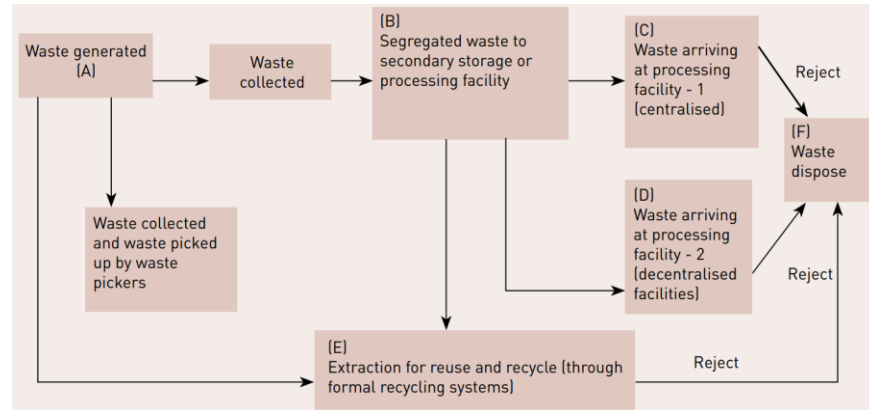
Stage III: Transportation to Disposal Sites

Transfer refers to the movement of waste or materials from collection points to disposal sites. Transportation of waste from collection point to disposal sites is carried out by using different types of vehicles depending on the distances to be covered by them. Larger vehicles carry the waste from the collection points to the disposal sites. Comparatively small vehicles discharge waste at transfer stations where the wastes are loaded into larger vehicles for transportation to the disposal sites. In metro cities transfer stations are located at different places to support intermediate transfer of waste from the surrounding areas up to the dumping grounds.

Transfer stations are centralized facilities where waste is unloaded from smaller collection vehicles and re-loaded into larger vehicles (including in some instances barges or railroads) for transportation to a disposal or processing site. The transportation of garbage from the transfer stations is done generally, using Trailers and Bulk Refuse Carriers. In large cities, open flatbed trucks, covered trucks, and some compactors are in use, whereas in smaller cities tractor-trailers, tricycles and animal carts are common. Study shows that in metros like, Mumbai, around 60 per cent of waste is transported through stationary compactors, mobile compactors and closed tempos; 10 per cent is through partially open dumpers whereas 20 per cent is through tarpaulin covered vehicles, which includes silt and debris.

Waste Flow Diagram

This chart depicts how the waste will flow, how the recycling, reusing is evaluated before they are sent for disposal.



(Source: Adapted from “Strategic Planning Guide for Municipal Solid Waste Management”. Environmental Resources Management (ERM), (2000), prepared for the World Bank, SDC and DFID by Waste-Aware, London)

Segregation and Disposal of Waste

3.6 The waste dumped in community bins is a mixed type of waste, i.e., all types of waste biodegradable, recyclable, inert and non-biodegradable waste is found in one bin, which become very hard to manage. Following table shows Variety of waste material generally found in a dustbin.

3.7 For disposal of solid waste commonly used methods are open dumps, landfills, sanitary landfills, and incineration plants. One of the important methods of waste treatment is composting. Selection of proper disposal method is necessary and primarily it depends on the ‘quantity of MSW generated and type of waste to be disposed’.

There is, however, no single technique which is suitable in all situations.

State	Total Wards	Ward with 100% segregation
Andaman & Nicobar	24	23
Andhra Pradesh	3409	3300
Assam	943	368

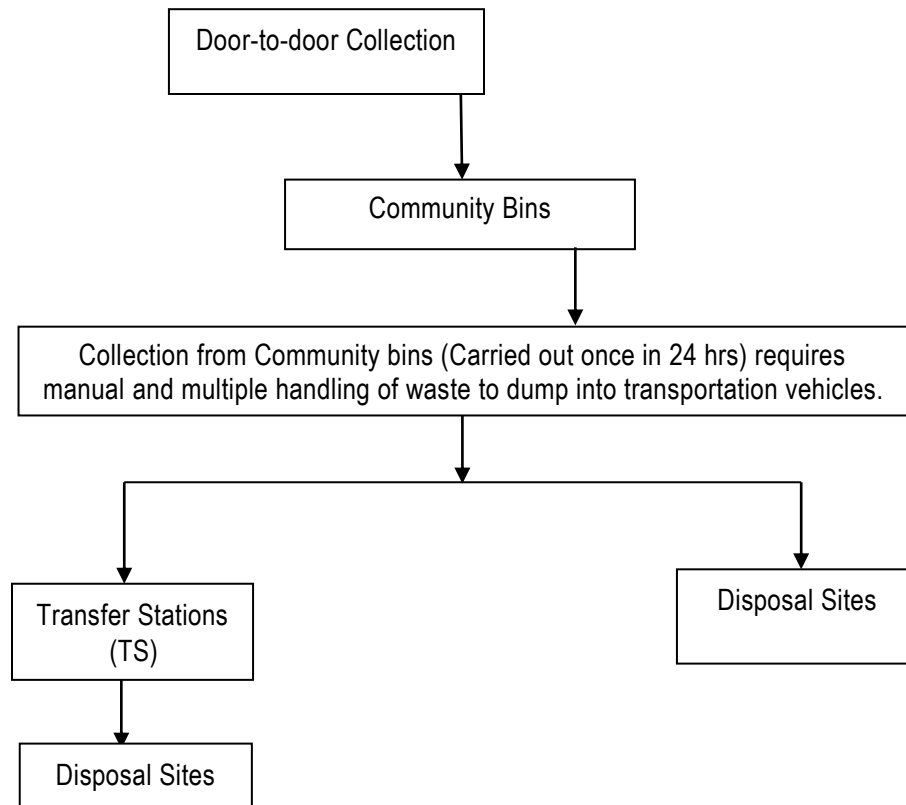
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State	Total Wards	Ward with 100% segregation
Arunachal Pradesh	75	11
Bihar	3377	1107
Chandigarh	26	24
Chhattisgarh	3217	3217
Daman & Diu	28	28
Delhi	294	54
Goa	217	173
Gujrat	1427	1187
Haryana	1496	935
Himachal Pradesh	497	490
Karnataka	6464	3694
Kerala	3536	3536
Madhya Pradesh	7115	7005
Maharashtra	7322	6346
Manipur	306	196
Meghalaya	114	27
Mizoram	264	230
Nagaland	234	30
Odisha	2024	1042
Puducherry	122	116
Punjab	3123	2664
Rajasthan	5389	4419
Sikkim	53	50
Tamil Nadu	12814	10891
Telangana	2112	1008

Segments in Waste Management Industry

State	Total Wards	Ward with 100% segregation
Tripura	310	243
Uttar Pradesh	12007	8294
Uttarakhand	1170	669
West Bengal	2938	558
Total	82447	63204

Collection and Transportation of Municipal Solid Waste



Classification of Waste

Biodegradable Wastes	Non-Biodegradable Wastes	
Organic Waste	Recyclable Waste	Others (Inorganic /Hazardous Waste)
• Used Tea Leaves/ powder	• Rubber	• Some medicines
• Egg Shells	• Shampoo bottles	• Paints
• Kitchen waste	• Glass	• Fluorescent tubes
• Fruit peels	• Wires	• Spray cans
• Meat	• Metal/ Metal objects	• Fertilizers and pesticide containers
• Bones	• Plastic	• Batteries
• Flowers	• Rags	• Shoe polish
• House dust after cleaning	• Leather	
• Garden Waste		

Industrial Waste

3.8 Industrial waste is the waste produced by industrial activity, such as that of factories, mills and mines. It has existed since the outset of the industrial revolution.

In a broad sense, industrial wastes could be classified into following two types:

(i) Hazardous Industrial Waste

Hazardous wastes, which may be in solid, liquid or gaseous form, may cause harm to health or environment, either alone or when in contact with other wastes. Various agencies have defined hazardous wastes in different ways and as such, there is no uniformly accepted international definition so far. It is presumed that about 10 to 15 percent of wastes produced by industries are

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hazardous and the generation of hazardous wastes is increasing at the rate of 2 to 4 percent per year.

Hazardous industrial wastes in India can be categorized broadly into two categories:

- (i) Hazardous wastes generated from various industries in India; and
- (ii) Hazardous industrial wastes imported into India from Western Countries for re-processing and recycling.

Inventoring of hazardous wastes generating units and quantification of wastes generated in India are being done by the respective State Pollution Control Boards (SPCBs).

Hazardous waste in particular includes products that are explosive, flammable, irritant, harmful, toxic, carcinogenic, corrosive, infectious, or toxic to reproduction.

Sources of Various Hazardous Waste

Hazardous Waste Component	Source
Heavy Metals	
Arsenic	Mining, non-anthropogenic geo-chemical formation
Cadmium	Mining, fertilizer industry, battery waste
Chromium	Mining areas, Tanneries
Lead	Lead acid battery smelters
Manganese	Mining areas
Mercury	Chlor-alkali industries, healthcare institute
Nickel	Mining, metal refining
Hydrocarbons	
Benzene	Petrochemical industries, solvents
Vinyl chloride	Plastics
Pesticides	Insecticides
Organic chemicals	
Dioxins	Waste incineration, herbicides
PCBs	Fluorescent lights, e-waste, Hydraulic fluid

(ii) Non-Hazardous Industrial Waste

Non-hazardous or ordinary industrial waste is generated by industrial or commercial activities but is similar to household waste by its nature and composition. It is not toxic, presents no hazard and, thus, requires no special treatment.

In particular, it includes ordinary waste produced by companies, shopkeepers, and traders (paper, cardboard, wood, textiles, packaging, etc.). Due to its non-hazardous nature, this waste is often sorted and treated in the same facilities as household waste.

Treatment Options for Non-hazardous Industrial Waste

3.9 Non-hazardous industrial wastes being diversified in their chemical nature, physical texture and moisture content and calorific values, etc., demand distinct treatment options which are broadly classified as follows:

Industries	Prominent Wastes Generated	Treatment Option	Application
Sugar Mills	Sugar bagasse	Combustion and Gasification	Heat and Power
	Press mud	Composting	Fertilizer
	Sugar molasses	Fermentation	Ethanol synthesis
	Fermentative Yeast biomass	Bio methanation	Biogas production and digestate
Slaughterhouses	Organs, Tissues, Blood, Hides, Animal excreta and Carcass, etc	Bio methanation	Biogas production and digestate
Paper mills	Pulp	Bio methanation	Biogas production and digestate
	Paper shavings	Combustion	Heat and power
	Wood wastes	Combustion and	Heat and power

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Industries	Prominent Wastes Generated	Treatment Option	Application
	and Paper boards	gasification	
Dairy Plants	Whey and Milk cream	Bio methanation	Biogas production and digestate
Sago factories	Starch materials and peels	Bio methanation	Biogas production and digestate
Tanneries	Hides and skins	Acid treatments and Bio methanation	Biogas production and digestate
Animal Husbandries	Animal excreta and body fluids	Bio methanation	Biogas production and digestate
Fruits and vegetable processing units	Pulp wastes	Bio methanation	Biogas production and digestate

Treatment options of Industrial waste has been mentioned elsewhere in the report under the head Disposal methods.

Bio-Medical Waste

3.10 The bio-medical waste is generated during the diagnosis, treatment of immunization of human beings or animals or in research activities pertaining thereto, or in the production or testing of biological components. The different location or points of generation of waste in a health care establishment are as follows:

- (i) Operation theatres / wards / labour rooms
- (ii) Dressing rooms
- (iii) Injection rooms
- (iv) Intensive Care Units

- (v) Dialysis room
- (vi) Laboratory
- (vii) Corridor
- (viii) Compound of hospital or nursing home

Bio-Medical Waste Rules

3.11 The Government of India as contemplated under Section 6,8 and 25 of the Environment (Protection) Act, 1986, has made the Bio-medical Waste Management Rules, 2016.

The rules are applicable to every institution generating bio-medical waste which includes hospitals, nursing homes, clinic, dispensary, veterinary institutions, animal houses, pathological lab, blood bank, etc.

Responsibilities of Hospitals

3.12 It is mandatory for such institutions to:

- Set up requisite bio-medical waste treatment facilities like, incinerators, autoclave, and microwave systems for treatment of the wastes, or ensure requisite treatment of the waste at a common waste treatment facility.
- Make an application to the concerned authorities for grant of authorization. A fee as prescribed shall accompany each application for grant of authorization.
- Submit a report to the prescribed authority by 31 January every year. The report should include information about the categories and quantities of bio-medical wastes handled during the preceding year.
- Maintain records about the generation, collection, reception, storage, transportation, treatment, disposal and / or any form of handling of bio-medical waste.
- Report of any accident to the prescribed authority.

Categories of Waste

3.13 The bio-medical wastes are categorized according to its characteristics taking into accounts its treatment and disposal. The different categories of waste as per the rule are given in following Table:

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Categories of Bio-medical Waste

Waste Category	Type of Waste	Treatment and Disposal Option
Category No. 1	Human Anatomical Waste (Human tissues, organs, body parts)	Incineration/deep burial
Category No. 2	Animal Waste (Animal tissues, organs, body parts, carcasses, Bleeding parts, fluid, blood and experimental animals used in research, waste generated by veterinary hospitals and colleges, discharge from hospitals, animal houses)	Incineration/deep burial
Category No. 3	Microbiology & Biotechnology Waste (Wastes from laboratory cultures, stocks or specimen of live microorganisms or attenuated vaccines, human and animal cell cultures used in research and infectious agents from research and industrial laboratories, wastes from production of biological, toxins and devices used for transfer of cultures)	Local autoclaving/ microwaving/ incineration
Category No. 4	Waste Sharps (Needles, syringes, scalpels, blades, glass,	Disinfecting (chemical treatment/ autoclaving/ microwaving and mutilation/ shredding
Category No. 5	Discarded Medicine and Cytotoxic drugs (Wastes comprising of outdated, contaminated and discarded medicines	Incineration / destruction and drugs disposal in secured landfills

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Waste Category	Type of Waste	Treatment and Disposal Option
Category No. 6	Solid Waste (Items contaminated with body fluids including cotton, dressings, soiled plaster casts, lines, bedding and other materials contaminated with blood.)	Incineration/autoclaving/microwaving
Category No. 7	Solid Waste (Waste generated from disposable items other than the waste sharps such as tubing, catheters, intravenous sets, etc.)	Disinfecting by chemical treatment/autoclaving/microwaving and mutilation/shredding
Category No. 8	Liquid Waste (Waste generated from the laboratory and washing, cleaning, housekeeping, and disinfecting activities)	Disinfecting by chemical Treatment and discharge into drains
Category No. 9	Incineration Ash (Ash from incineration of any biomedical waste)	Disposal in municipal landfill
Category No. 10	Chemical Waste (Chemicals used in production of biological, chemicals used in disinfecting, as insecticides, etc.)	Chemical treatment and discharge into drains for liquids and secured landfill for solids.

Segregation of Bio-Medical Waste

3.14 Colour Coding and Type of Container are as follows:

Colour Coding	Type of Container	Waste Category	Treatment Options (Schedule I)
Yellow	Plastic bag	Cat.1, Cat.2, Cat.3 & Cat.6	Incineration/ deep burial
Red	Disinfected container/plastic bag	Cat.3, Cat.6, & Cat.7	Autoclaving/Microwaving/ Chemical treatment

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Colour Coding	Type of Container	Waste Category	Treatment Options (Schedule I)
Blue/White Translucent	Plastic bag/puncture proof container	Cat.3, Cat.6, & Cat.7	Autoclaving/Micro waving/ Chemical treatment and destruction/shredding
Black	Plastic bag	Cat.5, Cat.9, & Cat.10 (solid)	Disposal in secured landfill

Personnel Safety Devices

3.15 The use of protective gears should be made mandatory for all the personnel handling waste:

(i) **Gloves:** Heavy-duty rubber gloves should be used for waste handling by the waste retrievers. This should be bright yellow in colour. After handling the waste, the gloves should be washed twice. The gloves should be washed after every use with carbolic soap and a disinfectant. The size should fit the operator.

(ii) **Aprons, Gowns, Suits or Other Apparels:** Apparel is worn to prevent contamination of clothing and protect skin. It could be made of cloth or impermeable material such as plastic. People working in incinerator chambers should have gowns or suits made of non-inflammable material.

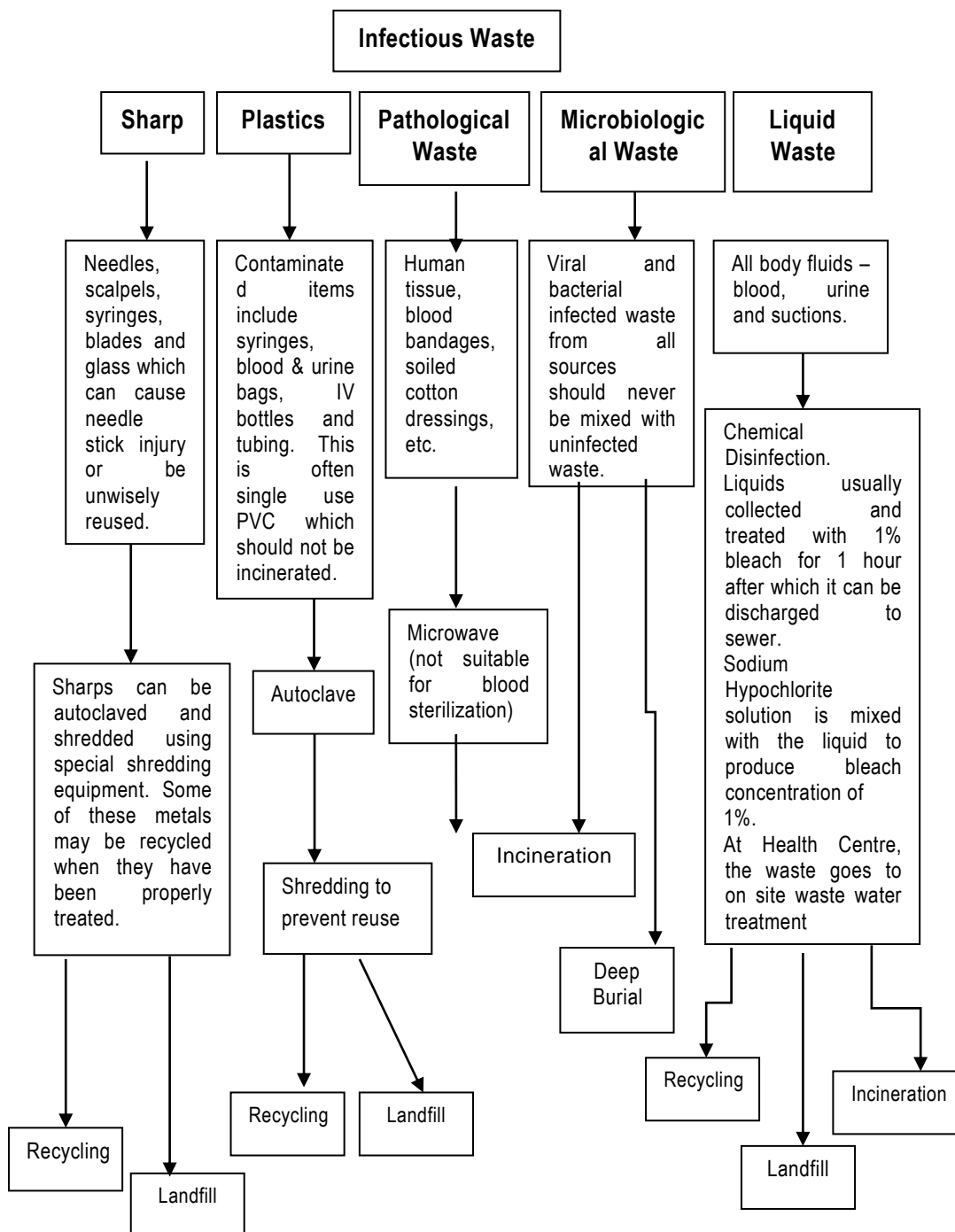
(iii) **Masks:** Various types of masks, goggles, and face shields are worn alone or in combination, to provide a protective barrier. It is mandatory for personnel working in the incinerator chamber to wear a mask covering both nose and mouth, preferably a gas mask with filters.

(iv) **Gum Boots:** Leg coverings, boots or shoe-covers provide greater protection to the skin when splashes or large quantities of infected waste have to be handled. The boots should be rubber-soled and anti-skid type. They should cover the leg up to the ankle.

(v) **Head Cover:** Covers the head, it has an elastic cuff that allows a proper seal. It is used to prevent the infections from spreading among health workers.

(vi) **Goggles/Face shield:** Covers the face and it aims to protect the wearer's entire face (or part of it) from hazards such as chemical splashes, or potentially infectious materials (in medical and laboratory environments).

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Treatment options of bio-medical waste have been mentioned elsewhere in the report under the head disposal methods.

Electronic Waste

3.16 The discarded and end-of-life electronics products ranging from computers, equipment used in Information and Communication Technology (ICT), home appliances, audio and video products and all of their peripherals are popularly known as electronic waste (E-waste).

The ill effects of e-waste could be on soil through leaching of hazardous contents from landfills; in water due to recycling process, if not carried out properly, can cause damage to human being through inhalation of gases during recycling, contact of the skin of the workers with hazardous substances and contact during acid treatment used in recovery process.

The hazardous and toxic substances found in e-waste include lead and cadmium in printed circuit boards (PCBs). Lead is primarily found in all electronic products/ assembly, cathode ray tubes (CRT), etc. Cadmium is found in monitor/ CRTs while there may be mercury in switches and flat screen monitors. Mercury is also found in CFL, relays and some other specific products. Besides computer batteries, cadmium is also used for plating metal enclosures/ metal parts in sub-assemblies. Polychlorinated biphenyls are found in capacitors and transformers and as brominated flame retardant on printed circuit boards, plastic casings, cable and polyvinyl chloride (PVC) cable sheathing for insulation and PBD/PBDE in plastic parts of electronics.

3.17 E-waste is not hazardous if it is stocked in safe storage or recycled by scientific methods or transported from one place to the other in parts or in totality in the formal sector. The e-waste can, however, be considered hazardous if recycled by primitive methods. E-waste contains several substances such as heavy metals, plastics, glass, etc., which can be potentially toxic and hazardous to the environment and human health, if not handled in an environmentally sound manner. E-waste recycling in the nonformal sector by primitive methods can damage the environment.

Greenpeace had undertaken a survey of the environmental pollution during manufacturing of electronic products in China, Thailand, Philippines and Mexico. The study is an assessment on pollution due to the use of some of the hazardous chemicals in the manufacture of electronic products in these countries. The industries included the printed circuit board and semiconductor

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chip manufacturing units and various assembly units of television, computers, monitors, etc. No such study has been carried out in India.

Effects of E-Waste on Health

Source of E waste	Constituent	Health effects
Solder in printed circuit boards, glass panels and gaskets in computer monitors	Lead (PB)	<ul style="list-style-type: none">• Damage to central and peripheral nervous systems, blood systems and kidney damage.• Affects brain development of children.
Chip resistors and semiconductors	Cadmium (CD)	<ul style="list-style-type: none">• Toxic irreversible effects on human health.• Accumulates in kidney and liver.• Causes neural damage.• Teratogenic.
Relays and switches, printed circuit boards	Mercury (Hg)	<ul style="list-style-type: none">• Chronic damage to the brain.• Respiratory and skin disorders due to bioaccumulation in fishes.
Corrosion protection of untreated and galvanized steel plates, decorator or hardener for steel housings	Hexavalent chromium (Cr VI)	<ul style="list-style-type: none">• Asthmatic bronchitis.• DNA damage.
Cabling and computer housing	Plastics including PVC	Burning produces dioxin. It causes <ul style="list-style-type: none">• Reproductive and developmental

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Source of E waste	Constituent	Health effects
		problems; • Immune system damage • Interfere with regulatory hormones
Plastic housing of electronic equipment and circuit boards.	Brominated flame retardants (BFR)	Disrupts endocrine system functions
Front panel of CRTs	Barium (Ba)	Short term exposure causes: • Muscle weakness; • Damage to heart, liver and spleen.
Motherboard	Beryllium (Be)	• Carcinogenic (lung cancer) • Inhalation of fumes and dust. Causes chronic beryllium disease or berylliosis • Skin diseases such as warts.

Management of E-waste

3.18 It is estimated that 75% of electronic items are stored due to uncertainty as to how manage it. These electronic junks lie unattended in houses, offices, warehouses, etc. and normally mixed with household wastes, which are finally disposed of at landfills. This necessitates implementable management measures.

In industries management of e-waste should begin at the point of generation. This can be done by waste minimization techniques and by sustainable product design. Waste minimization in industries involves adopting:

- Inventory management,
- Production-process modification,

- Volume reduction,
- Recovery and reuse.

Responsibilities of the Government

3.19 The following paragraphs give an overview of responsibilities of Government in waste management:

- (i) Governments should set up regulatory agencies in each district, which are vested with the responsibility of co-ordinating and consolidating the regulatory functions of the various government authorities regarding hazardous substances.
- (ii) Governments should be responsible for providing an adequate system of laws, controls and administrative procedures for hazardous waste management (Third World Network. 1991). Existing laws concerning e-waste disposal be reviewed and revamped. A comprehensive law that provides e-waste regulation and management and proper disposal of hazardous wastes is required. Such a law should empower the agency to control, supervise and regulate the relevant activities of government departments. Under this law, the agency concerned should:
 - Collect basic information on the materials from manufacturers, processors and importers and to maintain an inventory of these materials. The information should include toxicity and potential harmful effects.
 - Identify potentially harmful substances and require the industry to test them for adverse health and environmental effects.
 - Control risks from manufacture, processing, distribution, use and disposal of electronic wastes.
 - Encourage beneficial reuse of "e-waste" and business activities that use waste. Set up programs so as to promote recycling among citizens and businesses.
 - Educate e-waste generators on reuse/recycling options.
- (iii) Governments must encourage research into the development and standard of hazardous waste management, environmental monitoring and the regulation of hazardous waste-disposal.

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- (iv) Governments should enforce strict regulations against dumping e waste in the country by outsiders. Where the laws are flouted, stringent penalties must be imposed.
- (v) Governments should enforce strict regulations and heavy fines levied on industries, which do not practice waste prevention and recovery in the production facilities.
- (vi) Polluter pays principle and extended producer responsibility should be adopted.
- (vii) Governments should encourage and support NGOs and other organizations to involve actively in solving the nation's e-waste problems.
- (viii) Uncontrolled dumping is an unsatisfactory method for disposal of hazardous waste and should be phased out.
- (ix) Governments should explore opportunities to partner with manufacturers and retailers to provide recycling services.
- (x) Governments should adequately fund and financially support various initiatives and investments which are required to help towards sustainable developments both in the prevention of waste generation and its ill-effects and also in the economical solutions of waste management, especially recycling, etc.

Responsibility and Role of Industries

3.20 The following are major responsibilities and roles of industries in waste management:

- (i) Generators of wastes should take responsibility to determine the output characteristics of wastes and if hazardous, should provide management options.
- (ii) All personnel involved in handling e-waste in industries including those at the policy, management, control and operational levels, should be properly qualified and trained. Companies should adopt their own policies while handling e-wastes. Some are given below:
 - Use label materials to assist in recycling (particularly plastics).
 - Standardize components for easy disassembly.

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- Re-evaluate 'cheap products' use, make product cycle 'cheap' so that it has no inherent value that would encourage a recycling infrastructure.
 - Create computer components and peripherals of biodegradable materials.
 - Utilize technology sharing particularly for manufacturing and de manufacturing.
 - Encourage/ promote/ require green procurement for corporate buyers.
 - Explore and implement green packaging options.
- (iii) Companies should adopt waste minimization techniques, which will make a significant reduction in the quantity of e-waste generated thereby lessening the impact on the environment. It is a "reverse production" system that designs infrastructure to recover and reuse every material contained e-wastes metals such as lead, copper, aluminium and gold, and various plastics, glass and wire. Such a "closed loop" manufacturing and recovery system offers a win-win situation for everyone, less of the Earth will be mined for raw materials, and groundwater will be protected, researchers explain.
- (iv) Manufacturers, distributors, and retailers should undertake the responsibility of recycling/ disposal of their own products.
- (v) Manufacturers of computer monitors, television sets and other electronic devices containing hazardous materials must be responsible for educating consumers and the general public regarding the potential threat to public health and the environment posed by their products. All computer monitors, television sets and other electronic devices containing hazardous materials must be clearly labelled to identify environmental hazards and ensure proper materials management.

Responsibilities of the Citizen

3.21 Waste prevention is perhaps more preferred to any other waste management option including recycling. Donating electronics for reuse extends the lives of valuable products and keeps them out of the waste management system for a longer time. But care should be taken while donating such items, i.e., the items should be in working condition.

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Reuse, in addition to being an environmentally preferable alternative also benefits society. By donating used electronics, schools, non-profit organizations, and lower-income families can afford to use equipment that they otherwise could not afford.

E-wastes should never be disposed with regular home garbage and other household wastes. This should be segregated at the site and sold or donated to appropriate organizations.

While buying electronic products opt for those that:

- are made with fewer toxic constituents.
- use recycled content.
- is energy efficient.
- are designed for easy upgrading or disassembly.
- utilize minimal packaging.
- offer leasing or take back options.
- have been certified by regulatory authorities.

Customers should opt for upgrading their computers or other electronic items to the latest versions rather than buying new equipment.

Recycling

3.22 Today, the electronic waste recycling business is in all areas of the developed world a large and rapidly consolidating business. Part of this evolution has involved greater diversion of electronic waste from energy intensive down cycling processes, where equipment is reverted to a raw material form. This diversion is achieved through reuse and refurbishing. The environmental and social benefits of reuse include diminished demand for new products and virgin raw materials; larger quantities of pure water and electricity for associated manufacturing; less packaging per unit; availability of technology to wider swaths of society due to greater affordability of products; and diminished use of landfills.

One of the major challenges in e-waste is recycling the printed circuit boards. The circuit boards contain various precious metals such as gold, silver, platinum, etc. and base metals such as copper, iron, aluminium, etc. Conventional method employed is mechanical shredding and separation, but

the recycling efficiency is low. Alternative methods such as cryogenic decomposition have been studied for printed circuit board recycling, and some other methods are still under investigation.

Benefits of Recycling

3.23 Recycling raw materials from end-of-life electronics is the most effective solution to the growing e-waste problem. Most electronic devices contain a variety of materials, including metals that can be recovered for future uses. By dismantling and providing reuse possibilities, intact natural resources are conserved, and air and water pollution caused by hazardous disposal is avoided. Additionally, recycling reduces the amount of greenhouse gas emissions caused by the manufacturing of new products. It simply makes good sense to recycle waste and keep the environment green.

Hazardous Substances

3.24 The following are some of the hazardous substances:

Americium: The radioactive source in smoke alarms. It is known to be carcinogenic.

Mercury: It is found in fluorescent tubes (numerous applications), tilt switches (mechanical doorbells, thermostats and flat screen monitors). Health effects include sensory impairment, dermatitis, memory loss, and muscle weakness. Environmental effects on animals include death, reduced fertility, slower growth and development.

Sulphur: It is found in lead-acid batteries. Health effects include liver damage, kidney damage, heart damage, and eye and throat irritation. When released into the environment, it can create sulphuric acid.

BFRs: It is used as flame retardants in plastics in most electronics. Includes PBBs, PBDE, DecaBDE, OctaBDE, and PentaBDE. Health effects include impaired development of the nervous system, thyroid problems, and liver problems. Environmental effects: similar effects as in animals as humans. PBBs were banned from 1973 to 1977 and PCBs were banned during the 1980s.

Cadmium: It is found in light-sensitive resistors, corrosion-resistant alloys for marine and aviation environments, and nickel-cadmium batteries. The most common form of cadmium is found in Nickel-cadmium rechargeable batteries.

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These batteries tend to contain between 6 and 18% cadmium. The sale of Nickel-Cadmium batteries has been banned in the European Union except for medical use. When not properly recycled it can leach into the soil, harming microorganisms and disrupting the soil ecosystem. Exposure is caused by proximity to hazardous waste sites and factories and workers in the metal refining industry. The inhalation of cadmium can cause severe damage to the lungs and is also known to cause kidney damage.

Lead: It consists of solder, CRT monitor glass, lead-acid batteries, some formulations of PVC. A typical 15-inch cathode ray tube may contain 1.5 pounds of lead, but other CRTs have been estimated as having up to 8 pounds of lead.

Beryllium oxide: It is used as filler in some thermal interface materials such as thermal grease used on heat sinks for CPUs and power transistors, magnetrons, X-ray-transparent ceramic windows, heat transfer fins in vacuum tubes, and gas lasers.

Radioactive Waste

3.25 Nuclear power is the only large-scale energy-producing technology which takes full responsibility for all its wastes and fully costs this into the product. The quantity of radioactive wastes is very small relative to wastes produced by fossil fuel electricity generation. Used nuclear fuel may be treated as a resource or simply as a waste. Nuclear wastes are neither particularly hazardous nor hard to manage relative to other toxic industrial wastes. Safe methods for the final disposal of high-level radioactive waste are technically proven; the international consensus is that there should be geological disposal.

3.26 All parts of the nuclear fuel cycle produce some radioactive waste (radwaste) and the relatively modest cost of managing and disposing of this is part of the electricity cost, *i.e.*, it is internalised and paid for by the electricity consumers. At each stage of the fuel cycle there are proven technologies to dispose of the radioactive wastes safely. For low and intermediate level wastes these are mostly being implemented. For high-level wastes some countries await the accumulation of enough of it to warrant building geological repositories.

Unlike other industrial wastes, the level of hazard of all nuclear waste - its radioactivity - diminishes with time. The main objective in managing and

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disposing of radioactive (or other) waste is to protect people and the environment. This means isolating or diluting the waste so that the rate or concentration of any radionuclides returned to the biosphere is harmless. To achieve this, practically all wastes are contained and managed – some clearly need deep and permanent burial. From nuclear power generation, none is allowed to cause harmful pollution.

All toxic wastes need to be dealt with safely, not just radioactive wastes. In countries with nuclear power, radioactive wastes comprise less than 1% of total industrial toxic wastes (the balance of which remains hazardous indefinitely).

Types of radioactive wastes:

- (i) Exempt waste and very low level waste
- (ii) Low level waste
- (iii) Intermediate-level waste
- (iv) High-level waste

Exempt Waste and Very Low-Level Waste

3.27 Exempt waste and very low-level waste (VLLW) contains radioactive materials at a level which is not considered harmful to people or the surrounding environment. It consists mainly of demolished material (such as concrete, plaster, bricks, metal, valves, piping, *etc*) produced during rehabilitation or dismantling operations on nuclear industrial sites. Other industries, such as food processing, chemical, steel, *etc* also produce VLLW as a result of the concentration of natural radioactivity present in certain minerals used in their manufacturing processes.

Low-Level Waste

3.28 Low-level waste (LLW) is generated from hospitals and industry, as well as the nuclear fuel cycle. It comprises of paper, rags, tools, clothing, filters *etc*, which contain small amounts of mostly short-lived radioactivity. It does not require shielding during handling and transport and is suitable for shallow land burial. To reduce its volume, it is often compacted or incinerated before disposal. It comprises some 90% of the volume but only 1% of the radioactivity of all radioactive waste.

Intermediate-Level Waste

3.29 Intermediate-level waste (ILW) contains higher amounts of radioactivity, and some requires shielding. It typically comprises resins, chemical sludges, and metal fuel cladding, as well as contaminated materials from reactor decommissioning. Smaller items and any non-solids may be solidified in concrete or bitumen for disposal. It makes up about 7% of the volume and has 4% of the radioactivity of all radwaste.

High-Level Waste

3.30 High-level waste (HLW) arises from the 'burning' of uranium fuel in a nuclear reactor. HLW contains the fission products and transuranic elements generated in the reactor core. It is highly radioactive and hot, so requires cooling and shielding. It can be considered as the 'ash' from 'burning' uranium. HLW accounts for over 95% of the total radioactivity produced in the process of electricity generation. There are two distinct kinds of HLW:

- Used fuel itself.
- Separated waste from reprocessing the used fuel.

HLW has both long-lived and short-lived components, depending on the length of time it will take for the radioactivity of particular radionuclides to decrease to levels that are considered no longer hazardous for people and the surrounding environment. If generally short-lived fission products can be separated from long-lived actinides, this distinction becomes important in management and disposal of HLW.

3.31 In terms of radioactivity, high-level waste (HLW) is the major issue arising from the use of nuclear reactors to generate electricity. Highly radioactive fission products and also transuranic elements are produced from uranium and plutonium during reactor operations and are contained within the used fuel. Where countries have adopted a closed cycle and utilised reprocessing to recycle material from used fuel, the fission products and minor actinides are separated from uranium and plutonium and treated as HLW (uranium and plutonium is then re-used as fuel in reactors). In countries where used fuel is not reprocessed, the used fuel itself is considered a waste and therefore classified as HLW.

Low and intermediate-level waste is produced as a result of operations, such as the cleaning of reactor cooling systems and fuel storage ponds, the

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decontamination of equipment, filters and metal components that have become radioactive as a result of their use in or near the reactor.

3.32 Waste management for used fuel and HLW from nuclear power reactors:

Country	Policy	Facilities and progress towards final repositories
Belgium	Reprocessing	<ul style="list-style-type: none"> - Central waste storage at Dessel - Underground laboratory established in 1984 at Mol - Construction of repository to begin about 2035
Canada	Direct disposal	<ul style="list-style-type: none"> - Nuclear Waste Management Organisation set up in 2002 - Deep geological repository confirmed as policy, retrievable - Repository site search from 2009, planned for use 2025
China	Reprocessing	<ul style="list-style-type: none"> - Central used fuel storage at Lanzhou - Repository site selection to be completed by 2020 - Underground research laboratory from 2020, disposal from 2050
Finland	Direct Disposal	<ul style="list-style-type: none"> - Program started in 1983, two used fuel storages in operation - Posiva Oy set up in 1995 to implement deep geological disposal - Underground research laboratory Onkalo under construction - Repository planned from this, near Olkiluoto, open in 2020
France	Reprocessing	<ul style="list-style-type: none"> - Underground rock laboratories in clay and granite - Parliamentary confirmation in 2006 of deep geological disposal,

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Country	Policy	Facilities and progress towards final repositories
		containers to be retrievable and policy "reversible". - Bure clay deposit is likely repository site to be licensed 2015, operating 2025
Germany	Reprocessing but moving to Direct Disposal	- Repository planning started in 1973. - Used fuel storage at Ahaus and Gorleben salt dome Geological repository may be operational at Gorleben after 2025
India	Reprocessing	- Research on deep geological disposal for HLW
Japan	Reprocessing	- Underground laboratory at Mizunami in granite since 1996 - Used fuel and HLW storage facility at Rokkasho since 1995. - Used fuel storage under construction at Mutsu, start up 2013. - NUMO set up 2000, site selection for deep geological repository under way to 2025, operation from 2035, retrievable
Russia	Reprocessing	- Underground laboratory in granite or gneiss in Krasnoyarsk region from 2015, may evolve into repository - Sites for final repository under investigation on Kola peninsula - Pool storage for used VVER-1000 fuel at Zheleznogorsk since 1985 - Dry storage for used RBMK and other fuel at Zheleznogorsk from 2012 - Various interim storage facilities in operation

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Country	Policy	Facilities and progress towards final repositories
South Korea	Direct Disposal, may change	<ul style="list-style-type: none"> - Waste program confirmed in 1998, - KRWM set up in 2009 - Central interim storage planned from 2016
Spain	Direct Disposal	<ul style="list-style-type: none"> - ENRESA established in 1984, its plan accepted in 1999. - Central interim storage at Villar de Canas from 2016 (volunteered location) - Research on deep geological disposal, decision after 2010
Sweden	Direct Disposal	<ul style="list-style-type: none"> - Central used fuel storage facility – CLAB – in operation since 1985 - Underground research laboratory at Aspo for HLW repository - Osthrammar site selected or repository (volunteered location)
Switzerland	Reprocessing	<ul style="list-style-type: none"> - Central interim storage for HLW and used fuel at ZZL Wurenlingen since 2001 - Smaller used fuel storage at Beznau - Underground research laboratory for high-level waste repository at Grimsel since 1983 - Deep repository by 2020, containers to be retrievable
United Kingdom	Reprocessing	<ul style="list-style-type: none"> - Low-level waste repository in operation since 1959 - HLW from reprocessing is vitrified and stored at Sellafield. - Repository location to be on basis of community agreement.

Segments in Waste Management Industry

Country	Policy	Facilities and progress towards final repositories
		- New NDA subsidiary to progress geological disposal.
United States	Direct Disposal but reconsidering	<ul style="list-style-type: none"> - DoE responsible for used fuel from 1998, accumulated \$32 billion waste fund - Considerable research and development on repository in welded tuffs at Yucca Mountain, Nevada - The 2002 Congress decision that geological repository be at Yucca Mountain was countered politically in 2009.

3.33 Waste Generating Top Ten States are as follows:

State	(MT/D)
Maharashtra	22,080
Tamil Nadu	15,437
Uttar Pradesh	15,500
Delhi	10,500
Gujarat	10,274
Karnataka	10,000
Telangana	8,634
West Bengal	7,700
Rajasthan	6,500
Madhya Pradesh	6,424

Soil Pollution

3.34 Soil pollution is defined as the build-up in soils of persistent toxic compounds, chemicals, salts, radioactive materials, or disease-causing agents, which have adverse effects on plant growth and animal health.

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Soil is the thin layer of organic and inorganic materials that covers the earth's rocky surface. The organic portion, which is derived from the decayed remains of plants and animals, is concentrated in the dark uppermost topsoil. The inorganic portion made up of rock fragments, was formed over thousands of years by physical and chemical weathering of bedrock. Productive soil is necessary for agriculture to supply the world with sufficient food.

3.35 The different ways by which soil can be polluted are as below:

- Seepage from a landfill
- Discharge of industrial waste into the soil
- Percolation of contaminated water into the soil
- Rupture of underground storage tanks
- Excess application of pesticides, herbicides or fertilizer
- Solid waste seepage

The most common chemicals involved in causing soil pollution are as follows:

- Petroleum hydrocarbons
- Heavy metals
- Pesticides
- Solvents

3.36 Soil pollution is caused by the presence of man-made chemicals or other alteration in the natural soil environment. This type of contamination typically arises from the rupture of underground storage links, application of pesticides, percolation of contaminated surface water to sub-surface strata, oil and fuel dumping, leaching of wastes from landfills or direct discharge of industrial wastes to the soil. The most common chemicals involved are petroleum hydrocarbons, solvents, pesticides, lead and other heavy metals. The occurrence of this phenomenon is correlated with the degree of industrialization and intensities of chemical usage.

3.37 A soil pollutant is any factor which deteriorates the quality, texture and mineral content of the soil or which disturbs the biological balance of the organisms in the soil. Pollution in soil has adverse effect on plant growth. Pollution in soil is associated with:

Segments in Waste Management Industry

- Indiscriminate use of fertilizers
- Indiscriminate use of pesticides, insecticides and herbicides
- Dumping of large quantities of solid waste
- Deforestation and soil erosion.

3.38 The following are some effects of soil pollution as caused in different terrains of Agriculture, Industry or the Urban environment:

Agricultural	Industrial	Urban
<ul style="list-style-type: none"> • Reduced Soil fertility. • Reduced nitrogen fixation • Increased erodibility • Larger loss of soil and nutrients • Deposition of silt in tanks and reservoirs • Reduced crop yield. • Imbalance in soil fauna and flora 	<ul style="list-style-type: none"> • Dangerous chemicals entering underground water • Ecological Imbalance • Release of pollutant gases. • Release of radioactive rays causing health problems • Increased salinity • Reduced vegetation 	<ul style="list-style-type: none"> • Clogging of drains • Inundation of areas • Public health problems • Pollution of drinking water resources • Foul smell and release of gases • Waste management problems.

Waste Management in Villages

3.39 If there are some 25000 villagers, then the total waste generation may go up-to 7500 Kilograms of solid waste per day reveals a survey. Out of which 34.87% is organic; 61.57% is organic mixed with soil and remaining primarily consists of plastics on the roadside, vacant land and outskirts of the village. These non-biodegradable waste causes a number of problems for the environment, some of which include:

- hazardous emissions when waste is burnt.
- suffocation of soil biota caused when waste seeps into the soil in large volumes.

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- additional contamination occurring when regular waste is contaminated with biologically hazardous wastes such as, medical wastes and through materials such as, heavy metals from dry cell batteries.

3.40 The volume and variety of non- bio-degradable wastes will increase dramatically as average income rise and consumer items, particularly processed foods become more widespread. This will predominantly occur in lightweight packaging materials, which are not collected for recycling.

The legal responsibility for collecting, storing and disposing of these wastes lies with the local municipal authority. This responsibility falls on the local Panchayats. Unfortunately, providing SWM services to village residents has not caught their attention to date. However, this may change in the short to medium term. In the meantime, residual waste continues to be indiscriminately dumped throughout villages and surrounding farmlands.

There are certain NGOs like Exnora, Auroville which have taken initiatives in managing the waste in villages with the co-operation from Panchayat members.

Chapter 4

Disposal Methods

4.1 Improper and unscientific techniques adopted for Municipal Solid Waste (MSW) disposal are economically non-viable and socially unacceptable, due to this selection of proper disposal method is necessary. Quantity and characteristics of the MSW are two major factors, which are to be considered as the basis for the design of efficient, cost effective and environmentally compatible disposal method. One can choose the appropriate disposal method which is generally categorized on the basis of large scale and small-scale disposals below:

For Large Scale Disposal

Open Dumps

4.2 The cheapest and the oldest easy method of MSW disposal is 'open dumping' where the waste is dumped in low-lying areas on the city outskirts and levelled by bulldozers from time to time. Open dumping is not a scientific way of waste disposal. Open dumps refer an uncovered site used for disposal of waste without environmental controls. The waste is untreated, uncovered, and not segregated. In spite of its simplicity in execution, the financial involvement for this traditional method of waste management has been quite high particularly for the big metropolis. Uncontrolled, open dumps are not a sound practice. Open dumps are exposed to flies and rodents. It also generates foul smell and unsightly appearance. Loose waste is dispersed by the action of wind. Drainage from dumps contributes to pollution of surface and ground water and the rainwater run-off from these dumps contaminates nearby land and water thereby spreading disease.

Landfill

4.3 Disposing of waste in a landfill involves burying the waste, and this remains a common practice in most countries. Landfills are generally located in urban areas where a large amount of waste is generated and must be dumped in a common place. The equipment required to operate is relatively inexpensive and can be used for other municipal operations as well. Serious threat to community health represented by open dumping or burning is avoided in this method. Landfills are often established in abandoned or

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unused quarries, mining voids or borrow pits. Unlike an open dump, it is a pit that is dug in the ground. The waste is dumped, and the pit is covered at the dumping ground with debris/ soil and spread evenly in layers. At the end of each day, a layer of soil is spread on top of it and some mechanism, usually earth moving equipment is used to compress the garbage, which now forms a cell. Thus, every day, garbage is dumped and becomes a cell. The organic waste undergoes natural decomposition and generates a fluid, which is known as leachate, and is very harmful to the ecosystem. After the landfill is full, the area is covered with a thick layer of mud and the site can thereafter be developed as a parking lot or a park.

Sanitary Landfills

4.4 An alternative to landfills or modern landfill which solves the problem of leaching to some extent is a sanitary landfill which is more hygienic and built in a methodical manner. Designed “**landfill**” means a waste disposal site for the deposit of residual solid waste in a facility designed with protective measures against pollution of ground water, surface water and air fugitive dust, wind-blown litter, bad odour, fire hazard, bird menace, pests or rodents, greenhouse gas (Methane) emissions, slope instability and erosion. These are lined with materials that are impermeable such as, plastics and clay, and are also built over impermeable soil. Deposited waste is normally compacted to increase its density and stability and covered to prevent attracting vermin (such as mice or rats). Many landfills also have landfill gas extraction systems installed to extract the landfill gas. Gas is pumped out of the landfill using perforated pipes and flared off or burnt in a gas engine to generate electricity. Fully operated landfills may even enhance property values. Constructing sanitary landfills is very costly and they are having their own problems.

Ideal steps for designing, implementation and operation of a sanitary landfills are:

- Site selection.
- Sanitary landfill design
- Construction of sanitary landfill
- Sanitary landfill operation
- Closure and post closure plan.

4.5 A properly designed and well-managed landfill can be a hygienic and relatively inexpensive method of disposing of waste materials. Older, poorly designed, or poorly managed landfills can create a number of adverse environmental impacts such as, wind-blown litter, attraction of vermin, and generation of liquid leachate. Another common by-product of landfills is gas (mostly composed of methane and carbon dioxide), which is produced as organic waste breaks down aerobically. This gas can create odour problems, kill surface vegetation, and mainly is a greenhouse gas. By and large, crude dumping of waste is done in most of the cities without following the principles of sanitary landfilling. As negligible segregation of waste at source takes place, all waste including hospital infectious waste, generally, finds its way to the disposal site.

4.6 Quite often industrial hazardous waste is also deposited at dump sites meant for domestic waste. The waste deposited at the dump site is generally, neither spread nor compacted on a regular basis. It is also not covered with inert material. Thus, very unhygienic conditions prevail on the dump sites. Improperly managed and designed landfills attract all types of insects and rodents that spread disease.

4.7 Sanitary landfills are not properly practiced, and waste is dumped unattended in open sites, resulting in several hazards. In many sites compaction is not carried out and earth cover is not provided. Leachate if not treated properly it penetrates the soil and, if not prevented, pollutes the ground water. Also, flies, mosquitoes and many other pests breed on the waste and unless properly maintained, the dumps are a public health hazard. Some authorities claim that often the plastic liner develops cracks as it reacts with various chemical solvents present in the waste.

Unplanned land fill has caused an environmental disaster posing health hazards both to workers and to general public. The rate of decomposition in sanitary landfills is also extremely variable. This can be due to the fact that less oxygen is available as the garbage is compressed very tightly. It has also observed that some bio-degradable materials do not decompose properly in a landfill.

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The following table gives information on Solid waste dumpsites in all the states:

S. No.	States	Solid Waste Dumpsites		
		Total number of existing dumpsites	Dumpsites reclaimed/capped	Dumpsites converted to sanitary landfill
1	Andaman Nicobar	1	1	-
2	Andhra Pradesh	110	Kadapa Municipal Corporation	03
3	Arunachal Pradesh	31	Nil	Nil
4	Assam	76	Nil	Nil
5	Bihar	156	Nil	Nil
6	Chandigarh	01	01 (25 acres out of 45acres)	01 (8.28 acres of 25 acres)
7	Chhattisgarh	08	0	0
8	Daman Diu	Daman- 01 Diu-01	NIL	Daman- Development of scientific landfill site will be complete by 30.09.2019 Diu- Nil
9	Delhi	03	Nil	Nil
10	Goa	04	Nil	Nil
11	Gujarat	170	0	0
12	Haryana	65	00	00
13	Himachal Pradesh	54	1	Nil
14	Jharkhand	42	Nil	Nil
15	Jammu & Kashmir	Dumping near river, Open dumpsites, Open composting and etc	No Information provided	No Information provided

Disposal Methods

S. No.	States	Solid Waste Dumpsites		
		Total number of existing dumpsites	Dumpsites reclaimed/capped	Dumpsites converted to sanitary landfill
16	Karnataka	215	2	0
17	Kerala	52	-	-
18	Nagaland	13	-	-
19	Lakshadweep	9	Nil	Nil
20	Madhya Pradesh	378	10	1
21	Maharashtra	327	1	0
22	Manipur	21	-	-
23	Mizoram	1 (Aizawl) and 1 each 22 urban towns	Nil	Nil
24	Meghalaya	6	Nil	1
25	Orissa	18	Nil	Nil
26	Punjab	150	Nil	Nil
27	Pondicherry	3	-	-
28	Rajasthan	195	Under Process	Under Process
29	Sikkim	2	Nil	1
30	Tamil Nadu	140	3	0
31	Telangana	73	Greater Hyderabad Municipal Corporation at Jawaharnagar village	Greater Hyderabad Municipal Corporation at Jawaharnagar village
32	Tripura	17	14	Nil
33	Uttarakhand	42	Nil	Nil
34	Uttar Pradesh	609	1	0
35	West Bengal	100 ULB's are disposing waste at dumpsites.	1	Nil

(Source: Central Pollution Control Board, Annual report 2018-19)

Incineration

4.8 The process of burning waste in large furnaces is known as incineration. Incineration is a disposal method that involves combustion of waste material. Incineration and other high temperature waste treatment systems are sometimes described as "thermal treatment".

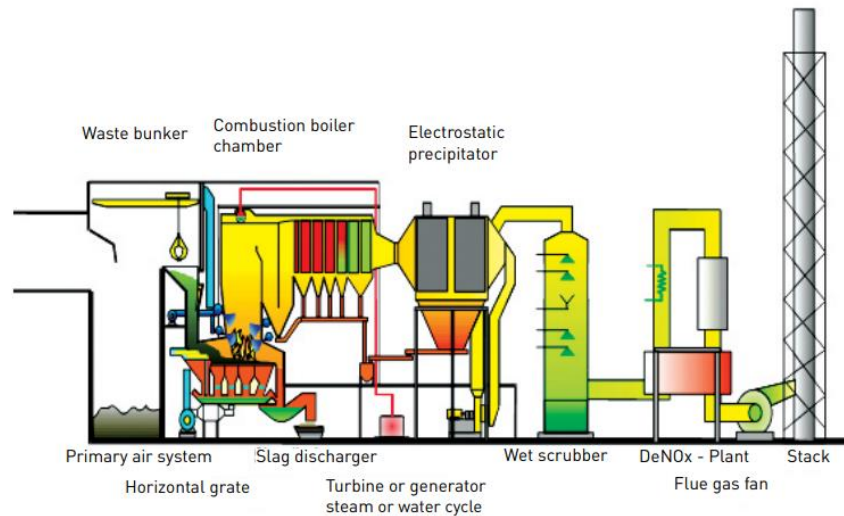
Incineration is carried out both on a small scale by individuals and on a large scale by industry. It is used to dispose of solid, liquid and gaseous waste. Incineration facilities, generally, do not require as much area as landfills. Waste-to-energy or energy-from-waste is broad terms for facilities that burn waste in a furnace or boiler to generate heat, steam and/or electricity. At the end of the process all that is left behind is ash. This method produces heat that can be used as energy. Incinerators convert waste materials into heat, gas, steam, and ash. It is recognized as a practical method of disposing of certain hazardous waste materials (such as, biological medical waste). Incineration of waste is a thermal process, which reduces the waste capacity down to 15-20 per cent.

However, due to lower calorific value of waste, this process has not been fully exploited.

4.9 Both the fly ash and the ash that is left in the furnace after burning have high concentrations of dangerous toxins such as, dioxins and heavy metals. Disposing of this ash is a problem. The ash that is buried at the landfills leaches the area and causes severe contamination.

Incineration is a controversial method of waste disposal, due to issues such as, emission of gaseous pollutants. Improperly operated incineration plants cause air pollution. Burning garbage is not a clean process as it produces tons of toxic ash and pollutes the air and water. Cost of incinerator and additional investment on pollution control devices make the process capital - intensive. Under Indian conditions large scale incineration plants are economically unviable in view of their capital-intensive nature and the low calorific value of city garbage available.

Typical Mass Burn Incinerator



Source: Waste-Non-Hazardous Waste-Municipal Solid Waste, USEPA.

For Small Scale Disposal

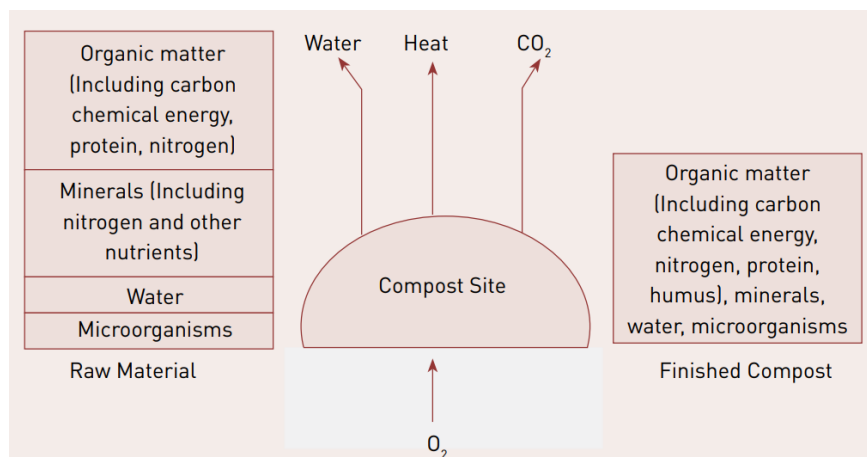
Composting

4.10 Decomposition and stabilization of solid organic waste material has been taking place in nature ever since life appeared on this planet. Composting is the process of decomposition and stabilization of organic matter under controlled condition. Waste materials that are organic in nature, such as, plant material, food scraps, and paper products, can be recycled using biological composting and digestion processes to decompose the organic matter. It is a biological process in which micro-organisms, mainly fungi and bacteria, convert degradable organic waste into humus like substance. The resulting organic material is then recycled as mulch or compost for agricultural or landscaping purposes. In addition, waste gas from the process (such as methane) can be captured and used for generating electricity. The intention of biological processing in waste management is to control and accelerate the natural process of decomposition of organic matter.

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4.11 There is a large variety of composting and digestion methods and technologies varying in complexity from simple home compost heaps to industrial-scale enclosed-vessel digestion of mixed domestic waste. Methods of biological decomposition are differentiated as being aerobic or anaerobic methods, though hybrids of the two methods also exist.

Process of Aerobic Composition is given in below chart:



Source: On-Farm Composting Handbook. Rynk, R., et al. 1992. Ithaca, New York: PALS Publishing Cooperative Extension.

Special Provisions for Hilly Areas

4.12 Cities and towns located on hills have location-specific methods evolved for final disposal of solid wastes by the municipal authority with the approval of the concerned State Board or the Committee. The municipal authority set up processing facilities for utilization of bio-degradable organic wastes. The inert and non-biodegradable waste is used for building roads or filling-up of appropriate areas on hills. In view of constraints in finding adequate land in hilly areas, wastes not suitable for road-laying or filling up is disposed of in specially designed landfills.

The Life Cycle of A Product

4.13 People associate waste with final disposal of a product, but waste occur at every stage in production process. Phases in life cycle of a product is depicted below, in which raw materials are turned into products, consumed

and then discarded. Then, the waste can be reused, recycled and disposed of.

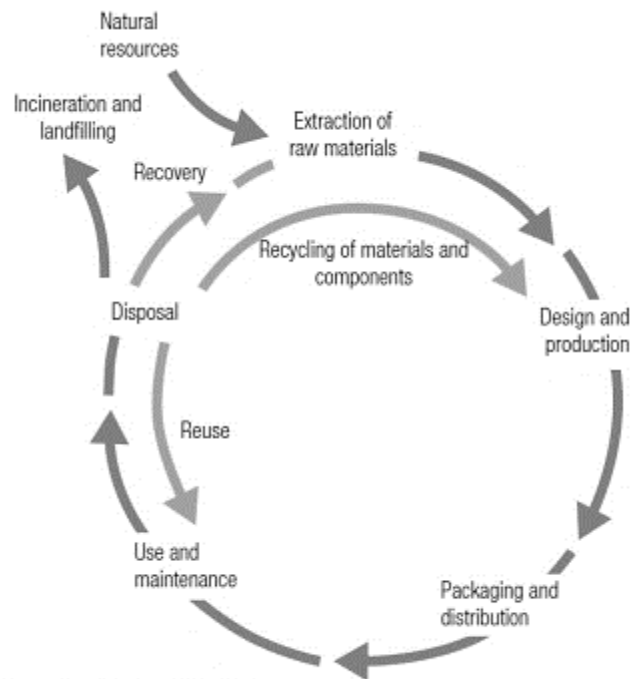


Figure 1 – Product Life Cycle

Source: UNEP/SETAC. Life Cycle Management: A Business Guide to Sustainability, Paris, 2007.

Generally, waste occurs from three stages of a product's life cycle:

- 1) the extraction and transformation of raw materials,
- 2) manufacturing and production of goods,
- 3) distribution and disposal of a product.

Life cycle thinking implies that we take account of a product's ecological footprint throughout its entire life. This helps us to estimate the entire environmental and social impact of the lifespan of a product, and not only the waste ending up in incinerators and landfills. Life cycle thinking and Life cycle management is widespread amongst local and national authorities. By taking the entire life cycle into account, policy makers may avoid shifting the environmental impact to another phase of a product's life cycle. Life cycle information also allows consumers to make informed decisions when purchasing a product.

Waste in All Stages of A Product

4.14 Extraction of raw materials, which is the first step in manufacturing any product, generates waste. Only a small share of the material contains elements that are used in the product. Secondly, the extraction of mineral from raw materials requires physical or chemical processes that also generate residues. As an example, a gold chain containing ten grams of gold may leave 5 tonnes of waste.

While it is estimated that the design of a product determines 70 - 90 per cent of the environmental impact of a product, the production phase involves generation of waste in form of excess materials.

The production of common packaging materials such as plastic, requires large amounts of chemicals. On the other hand, the distribution of products involves air emissions.

Usage and maintenance of a product, generates large amounts of hazardous waste. For example, the use and maintenance of a car requires for instance fuel, oils, lubricants, wax, paint, rubber, washing powder, not to mention acids and chemicals used in batteries, air condition systems, and brake systems.

Waste Management Hierarchy

4.15 Waste management hierarchy represents the internationally accepted preference of options for dealing with waste. Waste management should be performed in accordance with the following hierarchy, wherever practical and appropriate.

- Avoid or eliminate waste.
- Minimize waste.
- Re-use materials
- Recycle materials.
- Recover energy from waste.
- Dispose of residues appropriately

Detailed explanation of each is given below:

Avoid or Eliminate Waste

4.16 It includes action to reduce the amount of waste generated by households, industry and all levels of government.

Reduce

4.17 The most uncontrollable phase in Solid waste management is 'Waste generation'. Generated solid waste particularly from non-point sources is always a challenge for local administration, so best practice is to reduce the generation of Solid waste.

- The reduction of waste can happen only when everybody reduces waste generation in the first place.
- Every individual has to contribute by doing so. There is urgent need of public awareness about waste generation. There should be awareness at all levels of society, which will motivate them to change their casual habits which creates waste.
- Public Private Partnership should be engaged in this awareness activity.
- Definite Point Sources of waste generation like Hotels, Restaurant, and Shopping, Complexes, etc should contribute their space for disposal in their area itself, which ultimately reduces the burden of Collection.
- For Public Gatherings and Events organized in public places for any reason (including for processions, exhibitions, circuses, fairs, political rallies, commercial, religious, socio-cultural events, protests, and demonstrations, etc.), it will be the responsibility of the organizer of the event or gathering to ensure the cleanliness of that area.

Reuse

4.18 Utilization value of any item should be known to people who are using it.

- NGOs working for under privilege society should work for establishing centres which provides goods for secondary use. Such centres can be set up at the source.

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- Private sector involvement should be encouraged, repairing facilities should be offered so goods can be used as per its utilization value.
- Large production companies of electronic appliances, gadgets, etc should establish the collection centres, where damaged items can be repaired and reused.
- NGOs, Self-help group, etc can organize workshop, seminars which encourage people to use waste material to create some decorative articles.

Recycle

4.19 The process of transforming materials into secondary resources for manufacturing new products is known as recycling.

- Waste recycling leads to less utilization of raw materials, saves on landfill space, reduces the amount of energy required to manufacture new products. In fact, recycling can prevent the creation of waste at the source.
- Promoting/ motivating citizens to start segregation of waste at source involving NGO's, co-operatives, private, commercial, and industrial sectors for appropriate mass awareness campaigns.
- Source separation should be done by keeping recyclables and organics waste separate at source, i.e., at the point of generation facilitate reuse, recycling, and composting.
- Segregate the waste in the house by keeping two garbage bins and see to it that the biodegradable and the non-biodegradable is put into separate bins and disposed of separately. Biodegradable waste can be recycled.
- Dry waste consisting of cans, aluminium foils, plastics, metal, glass, and paper could be recycled.
- There should be recycling plant at local level.
- The least technically complex and most cost-effective solution should be chosen.
- Separation of waste for efficacious recycling and environmentally friendly purchasing habits are two areas for effective management.

Recover Energy from Waste

4.20 Consideration for recovering energy from the remaining wastes should be give post recovery of materials. This involves incinerating waste and utilising the heat that is created either directly or indirectly. Example: generating electricity.

Disposal

4.21 When all the disposal options are exhausted, residual wastes should be safely and responsible treated or disposed. Treatment here refers to the following:

- Incineration of non-hazardous waste without recovery of energy
- Physical-chemical treatment of chemical wastes to render them less harmful.

Responsible disposal of waste means depositing waste at a landfill which is designed to minimise the risk of pollution.

4.22 Practical examples of application of waste hierarchy is as follows:

Method	Examples
Waste avoidance	Returning unused materials to the supplier
Waste minimisation	Use of reusable material as far as practicable, to reduce the amount of waste being generated; Avoid ordering surplus materials
Reuse	Donation of old equipment to local community or schools; Repair and refurbishment of equipment
Recycling	Steel is 100% recyclable and can be reused over and over without any quality loss.
Energy Recovery	Local availability of energy from waste facilities to be determined
Responsible Disposal	Use on site incineration or develop own landfill site to reduce polluting potential of residual wastes

Pyrolysis/ Gasification

4.23 Pyrolysis is a process of chemical decomposition of organic matter brought about by heat. In this process, the organic material is heated in absence of air until the molecules thermally break down to become a gas comprising smaller molecules (known collectively as syngas). Pyrolysis is carried out at 500°C–1,000°C and produces three component streams i.e. Gas, Liquid & Char.

Gasification takes place as a result of partial combustion of organic matter in presence of a restricted quantity of oxygen or air. The gas so produced is known as producer gas. The gases produced by pyrolysis mainly comprise of carbon monoxide (25%), hydrogen and hydrocarbons (15%), and carbon dioxide and nitrogen (60%). The next step is to 'clean' the syngas or producer gas. Thereafter, the gas is burned in internal combustion (IC) engine generator sets or turbines to produce electricity.

Anaerobic Digestion/ Bio Methanation

4.24 In this process, the organic fraction of the waste is segregated and fed into a closed container (biogas digester). In the digester, the segregated waste undergoes biodegradation in presence of methanogenic bacteria and under anaerobic conditions, producing methane-rich biogas and effluent. The biogas can be used either for cooking/ heating applications, or for generating motive power or electricity through dual-fuel or gas engines, low pressure gas turbines, or steam turbines. The sludge from anaerobic digestion, after stabilization, can be used as a soil conditioner. It can even be sold as manure depending upon its composition, which is determined mainly by the composition of the input waste.

According to the Ministry of New and Renewable Energy (MNRE), 4.3 million family type biogas plants have been installed in India.

Applications of this method can be broadly categorised into following types:

- (a) Small Bio gas plants- E.g.: House old wastes, cattle waste based
- (b) Medium sized digesters – E.g.: Market wastes like flowers, fruits, vegetable and etc.
- (c) Large scale plants.

The General Process involved in the Bio methanation are:

- (a) Pre treatment
- (b) Biodegradation under the Anaerobic conditions
- (c) Collection of the Bio Gas
- (d) Residue Treatment.

The operating parameters of Bio methanation include, temperature, pH, moisture, toxicity, carbon to Nitrogen ratios, organic loading rate retention time and other factors.

Deep Burial

4.25 A pit or trench should be dug about 2 m deep. It should be half filled with waste, and then covered with lime within 50 cm of the surface, before filling the rest of the pit with soil. It must be ensured that animals do not have access to burial sites. Covers of galvanized iron/wire meshes may be used. On each occasion, when wastes are added to the pit, a layer of 10cm of soil be added to cover the wastes. Burial must be performed under close and dedicated supervision. The deep burial site should be relatively impermeable, and no shallow well should be close to the site. The pits should be distant from habitation and sited so as to ensure that no contamination occurs of any surface water or ground water. The area should not be prone to flooding or erosion. The location of the deep burial site will be authorized by the prescribed authority. The institution shall maintain a record of all pits for deep burial.

Autoclaving

4.26 The basic objective of autoclaving is to disinfection and treating biomedical waste.

- (i) When operating a gravity flow autoclave, medical waste shall be subjected to:
 - (a) A temperature of not less than 121°C and pressure of 15 pounds per square inch (psi) for an autoclave residence time of not less than 60 minutes; or
 - (b) A temperature of not less than 135°C and a pressure of 31 psi for an autoclave residence time of not less than 45 minutes; or

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- (c) A temperature of not less than 149°C and a pressure of 52 psi for an autoclave residence time of not less than 30 minutes.
- (ii) When operating a vacuum autoclave, medical waste shall be subjected to a minimum of one pre vacuum pulse to purge the autoclave of all air. The waste shall be subjected to the following:
 - (a) A temperature of not less than 121°C and a pressure of 15 psi for an autoclave residence time of not less than 45 minutes; or
 - (b) A temperature of not less than 135°C and a pressure of 31 psi for an autoclave residence time of not less than 30 minutes.
- (iii) Medical waste shall not be considered properly treated unless the time, temperature and pressure indicators indicate that the required time, temperature, and pressure is reached during the autoclave process. If for any reason, time, temperature, or pressure indicator indicates that the required temperature, pressure or residence time was not reached, the entire load of medical waste must be autoclaved again until the proper temperature, pressure and residence time were achieved.
- (iv) Recording of operational parameters– Each autoclave shall have graphic or computer recording devices which will automatically and continuously monitor and record dates, time of day, load identification number and operating parameters throughout the entire length of the autoclave cycle.

Despite the landfills have remained as a place of dump yard of the waste collected, they are no solution to the problem of waste management. The waste processing capacity in India is not at par with the quantity of waste being generated, and it is a major area of concern.

State	No of Plants	Installed capacity (tonnes per annum)	Operational Capacity (%)
Andaman & Nicobar	1	90	-
Andhra Pradesh	2	2,400	20
Assam	1	15,000	15
Chhattisgarh	1	1,200	20
Daman & Diu	1	4,050	-

Disposal Methods

Delhi	4	1,68,000	16.1
Goa	1	1,200	20
Gujrat	15	1,74,300	19.5
Haryana	4	18,600	15.3
Karnataka	18	4,73,400	10.1
Kerala	3	1,56,000	20
Madhya Pradesh	1	36,000	15
Maharashtra	13	4,88,400	12.5
Punjab	2	19,200	15
Rajasthan	1	1,80,000	15
Tamil Nadu	9	67,680	15.8
Telangana	5	1,92,000	15
Tripura	1	75,000	6
Uttar Pradesh	7	1,24,560	15.2
West Bengal	5	1,70,400	15
Total	95	23,67,480	14

(Source: 34th Report on Implementation of Policy on Promotion of City Compost, Standing Committee on Chemicals and Fertilisers of the 16th Lok Sabha (2017))

State	Total Wards	Total Waste Processing (%)
Andaman & Nicobar	24	95%
Andhra Pradesh	3409	63%
Assam	943	53%
Arunachal Pradesh	75	0%
Bihar	3377	51%
Chandigarh	26	95%
Chhattisgarh	3217	90%
Daman & Diu	28	75%
Delhi	294	55%

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State	Total Wards	Total Waste Processing (%)
Goa	217	70%
Gujrat	1427	87%
Haryana	1496	48%
Himachal Pradesh	497	78%
Jammu & Kashmir	1081	16%
Jharkhand	932	60%
Karnataka	6464	54%
Kerala	3536	71%
Madhya Pradesh	7115	87%
Maharashtra	7322	58%
Manipur	306	58%
Meghalaya	114	4%
Mizoram	264	35%
Nagaland	234	60%
Odisha	2024	48%
Puducherry	122	13%
Punjab	3123	61%
Rajasthan	5389	72%
Sikkim	53	70%
Tamil Nadu	12814	68%
Telangana	2112	78%
Tripura	310	53%
Uttar Pradesh	12007	58%
Uttarakhand	1170	46%
West Bengal	2938	9%
Total	84460	60%

Evaluation of Waste Management Options

4.27 An important element of waste management process is evaluating preferred waste management options. Formal assessment of Best Practical Environmental Option (BPEO) is recommended for hazardous wastes and a simplified assessment can be suitable for other waste streams. Evaluating waste management options should undertake waste hierarchy i.e., priority to be given to avoid and minimise generation of waste, followed by reuse, recycle and recovery with least preferred options. The option preferred should also consider social, economic and environmental considerations.

Assessment Methodology

4.28 Three steps assessment methodology as recommended is as follows:

- For each type of wastes, potential waste management options to be identified and evaluated.
- Screen identified options and eliminate impracticable options due to lack of availability or highly expensive
- Assess each remaining option, for each waste type against a set of objective criteria.

Evaluation Decision Criteria

4.29 To evaluate the suitability of various waste management options, decision criteria need to be developed. Examples of decision criteria are listed below:

Criteria	Comment
Cost	Cost associated with the investment including initial capital expenditure and all associated operational costs
Health & Safety	Risk of physical injuries/accidents through exposure to wastes
Operational feasibility	Significant changes to current operational practices may be a barrier
Local availability of technology	Check the availability of technology in country or there is a need to export

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Technical practicability	Technical challenges involved in implementation and deliverability including operational lead time and skill shortages. The chosen option must be practicable
Hazard reduction	Extent to which the hazard associated with waste is reduced
Resource consumption	Evaluation of fuel consumed in the transport of material and energy benefits from off-setting other fuels and recovery of materials
Regulatory and legal compliance	Evaluate the potential to meet local, regional, and international compliances and agreements
Long term liabilities	Check the long-term liabilities that would result from implementation of the option selected (e.g.: Loans outstanding)
Environmental impacts	Evaluate the impact on environment by selecting option based on the technology (E.g.: emission to air, water, etc)

Decision Score Card

4.30 Weightage need to be assigned to each criterion in the score card to reflect its relative importance of each criterion. Every short-listed option should then be scored (E.g.: between 1 to 5, where 1 representing poor performing criterion and 5 representing best performing criterion). The scores are the multiplied by the weight for each criterion and totalled to obtain the total score. Further, each option can be ranked to determine the best option. Excel spreadsheets can be used for same.

Sample score card is given below:

Criteria	Relative Weighting	Option 1		Option 2		Option 3	
		Score	Weighted score	Score	Weighted score	Score	Weighted score
Cost							
Health & Safety							
Social/Economic							

Disposal Methods

impact							
Environmental impact							
Local availability							
Technical practicality							
Total							

On-Site Waste Treatment and Disposal

4.31 This section relates to on-site treatment and disposal of non-mineral waste. Level of on-site waste management treatment required depends on the availability of local off-site waste management arrangements.

On-Site vs Off-Site Treatment of Waste

4.32 Advantages of on-site waste treatment are as follows:

- On-site waste treatment would help to apply Industry standards of health, safety and environmental protection.
- Reduction in volume can reduce the transportation cost.
- Treating waste so that it becomes less hazardous and lower the risk of accidents and reduce further disposal costs.

Alternatively, specialised waste management contractors may be better placed, in terms of skills, equipment and experience to undertake hazardous waste treatment. For each waste stream, an assessment should be made regarding the feasibility and value of treatment and disposal of waste on-site or to undertake pre-treatment before the waste is consigned to treatment of off-site disposal.

On-Site Waste Treatment (Pre-treatment) Options

4.33 List of pre-treatment, more comprehensive techniques and treatment that can be applied to reduce the volume of wastes on-site is as follows:

Treatment	Waste types	Purpose
Crushing *	Light bulbs (Fluorescent)	To reduce the hazard and volume
Piercing	Cans (Aerosol)	To reduce the hazard
Crushing *	Tins and cans	To reduce the volume

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Crushing *	Jars and glass bottles	To reduce the volume
Shredding	Drums, tyres	To reduce the volume
Baling and Crushing	Plastic bottles, paper, steel cans	To reduce the volume
Incineration	Sewage sludge, general mixed waste (non-hazardous)	To reduce the volume and remove polluting potential (organic content)
Incineration	Organic solvents, hazardous wastes	To reduce the hazard

* *Specialised equipment for specific type of waste*

When purchasing equipment for on-site waste treatment, it is important to consider how waste needs to be fed into and treated waste to be removed from the equipment. The more the hazardous waste, it becomes more important to empty the waste containers mechanically to minimise the risk of operators coming into contact with waste, wherever possible. A detailed risk analysis should be carried out before ordering the proposed system.

On-Site Waste Treatment Areas

4.34 A dedicated area should be established for treatment of waste on-site. This can be a part of a centralised area for storage and treatment of various types of non-mineral wastes.

Key features of such a centralised waste handling facility may be as follows:

- Security gates/fencing and signs
- Waste processing containers or building.
- Separate hazardous waste storage area if required.
- Area for loading, unloading and storing waste.
- Parking and vehicle turning area.
- Safety equipment including fire extinguishers, emergency eye wash/shower.
- Composting area, if required
- Hard standing area for large items (E.g.: asphalt/ concrete)
- Storage area for in used shipping containers.

Chapter 5

Laws and Regulations in India

5.1 Considering the waste generated in various forms and its impact on the environment, Indian Government has introduced laws and regulations. The laws and regulations introduced are based on the type of waste generated. The Government has in such laws clearly mentioned the ways/ methods through which the waste is to be managed or disposed, reporting requirements, record maintenance, segregation of waste at source, etc.

The provisions of laws introduced by the Government and important aspects of such laws from the internal auditor's perspective have been mentioned below.

- Bio-medical Waste Management Rules, 2016
- E-Waste (Management) Rules, 2022
- Solid Waste Management Rules, 2016
- Plastic Waste Management Rules, 2022
- Battery Waste Management Rules, 2022
- Construction and Demolition Waste Management Rules, 2016
- The Hazardous and Other Wastes (Management and Transboundary Movement) Rules, 2016

Bio-medical Waste Management Rules, 2016

5.2 These rules apply to all persons who generate, collect, receive, store, transport, treat, dispose, or handle bio-medical waste in any form. The said rules shall not be applicable to radioactive wastes, hazardous chemicals, solid wastes, lead acid batteries, hazardous wastes, E-waste, hazardous microorganisms, genetically engineered micro-organisms covered under the respective acts. Bio medical waste should not be mixed with other wastes. Such waste has to be segregated at the point of generation itself prior to its storage, transportation, treatment, and disposal. The containers should be labelled. For the container to be transported from the premises of generation of waste-to-waste treatment plant outside the premises it shall be labelled as prescribed in schedule III of this Act. Untreated bio-medical waste should not

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be kept stored beyond 48 hours provided, if necessary, permission has been obtained to store beyond the period specified in this Act.

In supersession of the Bio-medical Waste (Management & Handling Rules) 1998 issued under the Environment (Protection) Act, 1986 as notified by the Government of India has been revamped in 2016 to improve the collection, segregation, processing, treatment and disposal of bio-medical waste, the Central Government has reviewed the erstwhile Rules and introduced the Bio-Medical Waste Management Rules, 2016. From the times of outbreak of SARs-CoV-2 (COVID-19), these were further amended in 2019 and the medical sectors have been advised to treat, manage, and dispose the Bio Medical waste as per the said revised rules.

Duties of the Occupier

- It is the responsibility of the occupier to ensure that all the necessary steps are taken in order to safeguard the human health and environment,
- Make provision for safe handling and segregation of bio-medical waste,
- Pre-treat waste which requires sterilisation and disinfection,
- Phase out chlorinated plastic bags,
- Provide appropriate training and immunization to health care workers,
- Introduces Bar-code system for bags and containers,
- Ensure segregation, treatment, and disposal of liquid chemical waste,
- Maintain waste management register on a daily basis and display monthly record on the website,
- Reporting of major accidents during handling bio-medical waste and the remedial action taken,
- Upload the annual report on its website,
- Establish a review system and monitor activities through a committee,
- Maintain proper records of incineration, hydro or autoclaving for a minimum of 5 years.

Duties of the Operator

- Ensure no ill effects on human health and environment is caused

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- Collect the bio-medical waste from the occupier in a timely manner,
- Create bar coding and global positioning system,
- Make aware the authority of the occupiers who are not handing over segregated bio-medical waste,
- Give and assist in imparting training to the workers and to ensure their safety,
- Report major accidents in Form I,
- A logbook regarding the treatment,
- Publish details of authorisation, treatment, and annual report published in the official website.

In accordance with the said Rule, the Bio-Medical waste of health care facilities and common bio-medical waste treatment facility should be treated and disposed in accordance with Schedule-I and shall comply with standards as per Schedule-II of the said Rules. The untreated bio-medical waste shall not be mixed with other waste, and it shall be segregated in bags or container as specified in Schedule IV.

Every occupier or the operator of bio medical waste shall make an application for Authorisation in Form II and the authorisation shall be granted in Form III by the Central Pollution Control Board or the State Pollution Control Board. The occupier/operator of common bio-medical treatment facility need to submit the annual report in Form IV on or before 30th June for every year .

All the authorised persons have to maintain proper records related to generation, collection, reception, storage, transportation, treatment, disposal or handling for a period of 5 years as prescribed by the Authority or Central Pollution Control Board.

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Regulatory Compliances

Regulatory compliances to be followed for Bio-medical waste management are given below:

Rule No.	Requirement
Rule 4 (p)	Ensure to make available the annual report on the establishment's website within a period of 2 years from the publication of the Rules.
Rule 10	Make an application in Form II, to the State Pollution Control Board (SPCB) for grant of authorization The Authority shall grant authorization Form III The validity of such authorization, for bedded health care facility and operator of a common bio-medical waste treatment and disposal facility shall be synchronized with the validity of the consents
Rule 10 (1)	Make an application in Form II, to the State Pollution Control Board (SPCB) for grant of authorization The Authority shall grant authorization Form III The validity of such authorization, for non-bedded health care facility shall be one time
Rule 4 (i) and Rule 5 (c)	Establish a Bar- Code System for bags or containers containing bio-medical waste to be sent out of the premises or for the further treatment and disposal. Establish a Bar Code System for Effective Management of Bio-Medical Waste as per the Guidelines issued on 27th March, 2019.
Rule 10 (4)	Intimate to the prescribed authority, in case of any change in the bio-medical waste generation, handling, treatment and disposal for which authorisation was earlier granted and submit a fresh application in Form II for modification of the conditions of authorisation
Rule 4 (h) & (l) and Rule 5 (g) & (h)	Take the following health and safety measures to ensure occupational safety of the employee: 1. Immunise all the health care workers and others,

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Rule No.	Requirement
	involved in handling of bio-medical waste for protection against diseases including Hepatitis B and Tetanus that are likely to be transmitted by handling of bio-medical waste, in the manner as prescribed in the National Immunisation Policy or the guidelines of the Ministry of Health and Family Welfare issued from time to time; and 2. Provide appropriate and adequate personal protective equipment
Rule 4 (m)	Conduct health check up at the time of induction and at least once in a year for all the health care workers and others involved in handling of bio- medical waste and maintain the records for the same
Rule 4	Ensure to comply with the responsibilities of the occupier for management of hazardous and other wastes mentioned in the log sheet
Rule 4 (d) and 7 (8)	Phase out use of chlorinated plastic bags (excluding blood bags) and gloves.
Rule 7 (10)	Maintain a record of recyclable wastes which are auctioned or sold and submit it to the prescribed authority as part of its annual report
Rule 14	Submit an environmental statement for the financial year ending on the 31st of March in Form V to the concerned State Pollution Control Board on or before the thirtieth day of September every year, beginning 1993
Rule 7 (9)	Ensure that the recyclables from the treated bio-medical wastes (after ensuring treatment by autoclaving or microwaving followed by mutilation or shredding, whichever is applicable) such as plastics and glass shall be given to such recyclers having valid authorisation or registration from the respective prescribed authority
Rule 4 (o) and Rule 5 (i)	Report the following to the Authority, in case of the happening of any major accident, including accidents caused by fire hazards, blasts during handling of biomedical waste:

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Rule No.	Requirement
	1. Details of the accident; 2. Relevant records; 3. Remedial action taken (including NIL report); and 4. Annual Report Such report is to be filed in Form I
Rule 7 (3) & (4)	Ensure to set up requisite biomedical waste treatment equipment like: 1. Incinerator; 2. Autoclave or Microwave; 3. Shredder prior to commencement of the operation, as per the authorisation given by the prescribed authority
Rule 8	Untreated human anatomical waste, animal anatomical waste, soiled waste and, biotechnology waste shall not be stored beyond a period of forty - eight hours
Rule 13	Submit an Annual Report to the prescribed authority in Form-IV, on or before the 30th of June of every year
Rule 4 (g)	Provide training to all the health care workers and others, involved in handling of bio medical waste at the time of induction and thereafter at least once every year and the details of training programmes conducted, number of personnel trained and number of personnel not undergone any training shall be provided in the Annual Report
Rule 7 (5) & (6)	Send a request the Central Government for laying down the standards or operating parameters

E-waste (Management) Rules, 2022

5.3 The E-Waste Management Rules, 2022 is applicable to all individual/ organisations involved in manufacture, sale, transfer, purchase, collection, storage and processing of e-waste of electrical and electronic equipment listed in Schedule I but shall not apply to Micro, Small and Medium

Enterprises, used lead acid batteries and radioactive wastes covered under the specific acts.

The aim is reducing the use of hazardous substances in electrical and electronic equipment by specifying the threshold for use of such hazardous materials including lead, mercury and cadmium. It shall apply to every producer, consumer or bulk consumer, collection centre, dismantler and recycler of e-waste involved in the manufacture, sale, and purchase and processing of electrical and electronic equipment or components. There are certain exceptions for applicability of these rules like these rules are not applicable to micro and small enterprises as defined in Micro, Small and Medium Enterprises Development Act, 2006. As per these rules the main responsibility for waste management is on the producers of electrical and electronic equipment through the introduction extended producer responsibility.

5.4 Extended producer responsibility requires personal computer manufacturers, mobile handset makers and white good makers to come-up with e-waste collection centres or introduce 'take back' systems. Records have to be maintained regarding generation of E-waste and make such records available with State Pollution Control Boards or the Pollution Control Committee.

Every producer, manufacturer, dismantler, recycler and refurbisher needs to apply for authorisation in Form 1 for Extended Producer Responsibility

Responsibilities

As a Manufacturer

- To collect, recycle, and dispose any e-waste and to make sure that no damage is caused to the environment.
- To apply for authorisation in Form 1(a).
- Maintain proper records in Form 2 relating to E-waste generated, handled and disposed.
- To file Form 3 (Annual Return) on or before 30th June every year.

As a Producer

- To implement the Extended Producers responsibility with its framework.
- To file for authorisation in Form 1.

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- Maintenance of records in Form 2 and filing annual returns in Form 3.
- If the producer operates without an Extended Producer responsibility, it shall be considered as damage to the environment.

As a Collection Centre

- Collect E-waste on behalf of the producer, dismantler, recycler, or refurbisher.
- Ensure the secure storage of the collected e-waste till it is sent to authorised dismantler or recycler.
- As per the Guidelines of CPCB maintain records in Form 2.

Other than the above, there are Certain other responsibilities mentioned by the CPCB for dealers, refurbisher, consumer or bulk consumer, dismantler, recycler, and the State Government.

The CPCB can also conduct a random sampling of the electric or electronic equipment to verify, monitor and to check the compliance.

The State Pollution Control Board has the power to suspend or cancel the EPR Authorisation if the authorisation holder does not comply with the rules or provisions mentioned as per the E-Waste (Management) Rules, 2016.

Every manufacturer, producer, consumer, dealer, refurbisher, dismantler, recycler has to comply with the procedure for storage of e-waste as per the Rules, which is not greater than a period of 180 days. He shall maintain proper record of collection, sale, transfer and storage of such e-waste and make it available for inspection. The SPCB may on request extend the period said above up to 365 days.

SPCB must prepare and submit an annual report to CPCB on or before 30th September every year in Form 5.

Regulatory Compliances

Regulatory compliances to be followed for E-waste management are given below:

Rule No.	Requirement
Rule 13 (3) (vii), Rule 11 (9), Rule 10 (8), Rule 9 (4), Rule 8(6), 13 (4) (v), Rule 5 (5), Rule	File annual returns in Form 3, to the concerned State Pollution Control Board on or before the 30th day of June

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Rule No.	Requirement
13 (1) (xi), Rule 4 (5) and Rule 13 (2)(v)	following the financial year to which that return relates.
Rule 9 (1)	Ensure that e-waste generated by them is channelised through collection centre or dealer of authorised producer or dismantler or recycler or through the designated take back service provider of the producer to authorised dismantler or recycler
Rule 9 (3)	Ensure that end-of-life electrical and electronic equipment are not admixed with e-waste containing radioactive material as covered under the provisions of the Atomic Energy Act, 1962 (33 of 1962).
Rule 4 (4), Rule 5 (4), Rule 9 (2), Rule 8 (7), 13 (4) (v), Rule 13 (1) (xi), Rule 13 (2) (v), Rule 13 (3) (vii), Rule 11 (8), Rule 10 (7) and Rule 6(5)	Maintain records of collection, sale, transfer and storage of e-waste generated in Form-2 and make such records available for scrutiny by the Central Pollution Control Board or the concerned State Pollution Control Board.
Rule 15	Ensure not to store e-waste beyond the period of 180 days.

Solid Waste Management Rules, 2016

5.5 It applies to every urban local body, towns, etc. responsible for collection, segregation, storage, transportation, processing, and disposal of municipal solid waste. In Supersession of Municipal Solid Wastes (Management and Handling) Rules, 2000, these rules shall be applicable to every person as specified in the Solid Wastes (Management and Handling) Rules, 2016.

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The Municipal Solid Wastes (Management and Handling) Rules, 2016 has specified duties as follows:

- Waste generators
- Ministry of Environment, Forest and Climate Change
- Ministry of Urban Development, Department of Fertilizers
- Ministry of Chemicals and Fertilizers
- Ministry of Agriculture
- Ministry of Power
- Ministry of New and Renewable Energy Sources
- Secretary in-charge of Urban Development in State and Union Territories
- District Magistrate/ Collector/ Commissioner
- Secretary-in-charge of Village Panchayats or Rural Development Department in the State and Union territory
- Central Pollution Control Board
- Local authorities and village Panchayats of census towns and urban agglomerations
- State Pollution Control Board and Pollution Control Committee
- Manufacturers or brand owners of disposable products and
- Industrial units located within one hundred km from the refused derived fuel and waste to energy plants based on solid waste.

Each of the above need to refer to the duties prescribed in the said Rules and act accordingly.

The State Pollution Control Board/Central Pollution Control Committee shall grant authorisation of submitting Form I from the local bodies, the authorisation shall be granted in Form II,

Annual Reports

- Annual Report to the local body in Form-III shall be submitted on or before 30th April every year by the operator of the facility.

- The local body shall submit its annual report in Form-IV to the State Pollution Control Board and Secretary in-charge of Urban Development in State and Union Territories in Form-IV on or before 30th June every year.
- Each State Pollution Control Board or Pollution Control Committee shall prepare a consolidated annual report and submit it to Central Pollution Control Board and Ministry of Urban Development reporting on the steps taken for implementation and non-compliance on or before 31st July every year in Form-V.
- The Central Pollution Control Board shall review and submit the annual review report which is consolidated and submit the same to the Ministry of Urban Development and Ministry of Environment, Forest, and Climate Change, which will finally be reviewed.

In case of any major accidents, the same needs to be reported in Form-VI by the Officer in charge to the local body.

Specifications for Sanitary Landfills as per Schedule I, Standards of processing and treatment of solid waste as per Schedule II needs to be referred from the Rules for complying with the said Rules.

Plastic Waste Management Rules, 2022

5.6 This rule shall be applicable to all generators of waste, producers, manufacturers, importers, etc but shall not be applicable to export-oriented units, SEZ units and others as mentioned by the Central Government, manufacturing against order for export. There is no exemption to Units engaged in packaging of gutkha, tobacco, pan masala and the like.

Certain conditions for use of plastic such as the carry bag or plastic packaging will be in the natural shade, recycling of plastic and determination of degradability and disintegration of plastic shall be in conformity with Indian Standards, any form of recycled plastic should not be used for storing or packing any ready to eat food items, thickness shall not be less than 50 microns and no manufacturer shall sell/provide/arrange plastic to be used as a raw material according to the rules.

Plastic waste management such as use of plastic for construction of roads and thermos-plastic should be processed first and disposed thereafter should be encouraged.

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The local bodies should create awareness among all the stakeholders/waste generators, ensure that the waste is properly segregated, processed, recycled, or disposed of, take steps to safeguard the environment and prevent open burning of plastic does not take place. The waste generator should take all the necessary steps and actions to minimize the waste created.

Other rules such as marking and labelling of the plastic carry bag, registration of producer/recycler/manufacture, filing of the Annual report in Form IV by every person, local body, State Pollution Control Board and Central Pollution Control Board within 30th April every year and other Forms needs to be complied as per the Plastic Waste Management Rules, 2022.

Some of the salient features of these Rules are:

- Use of plastic materials in sachets for storing, packing, or selling gutkha, tobacco and pan masala has been banned.
- Food stuffs will not be allowed to be packed in recycled plastics.
- Recycling of plastic waste shall conform with Indian Standard IS 14534:1998
- Plastic carry bags shall either be in natural shades which is without any added pigments or made using only those pigments and colorants which are in conformity with the Indian Standard: IS 9833:1981.
- Plastic carry bags shall not be of less than 50 microns in thickness.
- The new Rules have stipulated provisions for marking or labelling to indicate name, registration number of the manufacturer, thickness and to indicate whether they are recycled or compostable.

Battery Waste Management Rule, 2022

The Battery Management Rule, 2022 was issued in supersession of the Battery Management Rule, 2001. These Rules apply to producer, dealer, consumer, and entities involved in collection, segregation, transportation, refurbishment and recycling of waste battery except for that equipment in connection with essential security, arms, ammunitions, war material and equipment for military purposes.

Regulatory Compliances

Regulatory compliances to be followed for Battery waste management are given below:

Rule No.	Requirement
Rule 10(2)(ii)	File a half yearly return in Form VIII to the State Pollution Control Board.

Functions of the Producer

- (a) The Producer needs to adhere to the prohibitions and labelling requirements prescribed in Schedule I and also ensure that handling of waste battery would not damage the environment.
- (b) It shall be the obligation of the Producer for Extended Producer Responsibility for the battery introduced in the market until recycling and refurbishing obligations as mentioned in Schedule II and provide the EPR Plan in Form I(C) to Central Pollution Control Board.
- (c) The battery manufacturer needs to get registered through online centralised portal in Form 1(A) and the certificate shall be issued in Form 1(B).
- (d) It is the duty of the producer to bring to the notice of CPCB or SPCB of any violations of a person/entity in handling and management of waste battery.

Function of the Consumer

- (a) the consumers must discard battery waste in an environment friendly way and separate from other waste streams
- (b) the battery waste shall be collected, segregated, and treated as per the guidelines/standards prescribed by the CPCB

Function of the Public Waste Management Authorities

The function of Public Waste Management Authorities is to handover the collected battery waste to the producers/agencies involved in the refurbishment and recycling with a view to refurbish or recycle the same. The entity involved in collection, segregation and treatment shall hand over the collected waste to the refurbisher or recycler.

Function of the Refurbisher and Recycler

- a) the refurbisher and recyclers of Battery waste have to get registered under State Pollution Control Board vide Form 2(A) and certificate of registration shall be issued in Form 2(B) through the online portal
- b) refurbisher and recyclers should furnish quarterly returns in Form 4 regarding the details of quantity collected, refurbished, recycled and disposal of such quantities

The State Pollution Control Board and the Central Pollution Control Board shall adhere to the functions as prescribed in the said rules.

Action on Violations and Imposition of Environmental Compensation

The polluter shall be levied Environmental Compensation for the following activities:

- a) activities carried out by entities without registration
- b) material facts wilfully concealed, and information falsely provided by the registered entities under these rules
- c) documents submitted by forging or manipulated documents by the registered entities under these rules
- d) mishandling of waste battery by those entities involved in collection, segregation, and treatment
- e) The CPCB shall levy Environmental Compensation on the producer in case of non-fulfilment of EPR responsibilities and obligations
- f) The SPCB shall levy Environmental Compensation on the refurbisher, recycler and entities involved in collection, segregation, and treatment of battery waste with regards to the non-fulfilment of responsibilities and obligations
- g) EPR Obligations shall not be absolved to the Producers on payment of Environmental Compensation and the unfulfilled EPR shall be carried forward to the next year for a period of 3 years

Construction and Demolition Waste Management Rules, 2016

The Construction and Demolition Waste Management Rules, 2016 shall apply to every waste resulting from construction, re-modelling, repair and demolition of any civil structure of any individual/organisation/authority.

Duties

Duties of the Waste Generator - Any generator of waste as per the applicability of the said rules is responsible for the collection, segregation along with storing and disposing of separately; he must ensure that the waste is collected within the premise or deposited at collection centre or handover to the authorised processing facilities and shall pay the relevant charges for the disposal activities.

Duties of the Service Provider - The service provider shall prepare an comprehensive waste management plan covering segregation, storage, collection, reuse, recycling, transportation and disposal of construction or demolition waste; and he or with support of the logistics shall also make sure that waste is cleared on a daily basis.

Duties of the Local Authority - The local authorities shall issue a detailed direction regarding proper management of construction and demolition waste, seek required assistance from the concerned authorities, arrange for proper place and containers for collection of waste, keep a track of generation of construction and demolition waste generated.

Duties of Others - The said rules also mention the following:

- Duties of State Pollution Control Board or Pollution Control Committee,
- Duties of State Government or Union Territory Administration,
- Duties of Central Pollution Control Board,
- Duties of Bureau of Indian Standards, and Indian Roads Congress,
- Duties of Central Government

So, the respective bodies need to refer the said rules. The criteria for storage, processing or recycling facilities for construction and demolition waste and application of construction and demolition waste and its products.

Hazardous and Other Wastes (Management and Transboundary Movement) Rules, 2016

Hazardous and Other Wastes (Management and Transboundary Movement) Rules, 2016 have been framed in order to help in the management of hazardous and other wastes as specified in Schedule II of these rules but not applicable to wastewater and exhaust gases, bio-medical waste, radio-active waste, municipal solid waste and wastes arising from operation of ships which are covered under the respective acts.

Each occupier of the facility, who is involved in the activities described in these rules have to make an application to the SPCB in Form 1 and the SPCB shall grant authorisation in Form 2 and obtain renewal before 3 months of expiry as the case may be. If the occupier violates or fails to comply with to any rules mentioned hereunder, the SPCB may suspend or cancel the authorisation.

The occupier needs to maintain proper records in Form 3 and submit an annual report to the SPCB in Form 4 on or before 30th June every year.

The storage, utilisation, standard operating procedures, or guidelines; Import and export; Treatment, storage, and disposal facilities; Packing, labelling and transport of hazardous wastes are described under the rules.

The Hazardous and Other Wastes (Management and Transboundary Movement) Rules, 2016 has described a set of duties pertaining to the hazardous and other wastes of the Occupier and the State Government, some of the important responsibilities and duties are mentioned as below:

Responsibilities of the Occupier

- (a) The occupier must ensure that following important steps are taken for the safe and sound management of the hazardous and other wastes in order to contain contaminants and prevent accidents which are namely,
- prevention, minimization, reuse, recycle, recovery and safe disposal.
- (b) The said wastes under these rules have to be sent/sold to the authorised actual user or a disposal facility.

Duties of the State Government

Following are duties of State Governments for Environmentally sound management hazardous and other wastes:

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- (a) The Department of Industry or any other Government agency must ensure the allocation of industrial space/shed for recycling, pre-processing, and other related activities.
- (b) The Department of Labour should recognise and register the workers involved in recycling/management of such wastes, assist in setting up such facilities, to undertake skill development activities, safety of the workers and annual monitoring of the activities.
- (c) Every State government shall prepare a plan for implementation of these Rules and submit an annual report to the Ministry of Environment, Forest, and Climate Change, in the Central Government.

Regulatory Compliances

Regulatory compliances to be followed for Hazardous and Other Wastes management are given below:

Rule No.	Requirement
Rule 6(1), (1A)	Make and application in Form 1 and obtain an authorisation from the State Pollution Control Board within a period of sixty days from the date of publication of these rules
Rule 4	Ensure to comply with the responsibilities of the occupier for management of hazardous and other wastes mentioned in the log sheet
Rule 6 (1)	Ensure that an application for renewal of authorisation may be made three months before the expiry of such authorisation.
Rule 8	Store the hazardous and other wastes for a period not exceeding ninety days and shall maintain a record of sale, transfer, storage, recycling, recovery, pre-processing, co-processing and utilisation of such wastes and make these records available for inspection.
Rule 6 (5)	Submit to the State Pollution Control Board, an annual return containing the details specified in Form 4 on or before the 30th day of June following the financial year to which that return relates.
Rule 18	Ensure to comply with the conditions mentioned in the log sheet for transportation of hazardous and other wastes

Waste Management Technologies

The Central Board of Pollution Control, Delhi has issued the protocols on Evaluation of Technology for Waste Management. This is to ensure that the technologies used for waste management are viable and effective. Initiatives such as Swachh Bharath has given guidance for the waste management infrastructure in the country. In addition to the above, various provisions of Waste Management Rules are described in the protocols. For detailed description of the provisions of protocols on waste management, the reader should refer these Rules.

A committee has been formed to comply with these requirements to guide the development of the technologies and waste management practices and these set of protocols are the standard procedures suggested in order to evaluate technologies used and to recommend the suitable and viable.

Government Initiatives

5.7 “Swachh Bharat Abhiyan” is the most significant cleanliness campaign by the Government of India. The Prime Minister Shri Narendra Modi led a cleanliness pledge at India Gate, which about thirty lakh government employees across the country joined. The Swachh Bharat Mission (SBM) was introduced in India in 2014 with the aim of eliminating open defecation and improving the solid waste management. The mission is spilt into two parts:

- SBM Gramin for rural areas overseen by Ministry of Drinking Water and Sanitisation, and
- SBM Urban for urban areas overseen by the Ministry of Housing and Urban Affairs.

He also flagged off a walkathon at Rajpath and surprised people by joining in not just for a token few steps but marching with the participants for a long way. By inviting people to participate in the drive, the Swachh Abhiyan has turned into a National Movement. A sense of responsibility has been evoked among the people through the Clean India Movement. With citizens now becoming active participants in cleanliness activities across the nation, the dream of a ‘Clean India’ once visualised by Mahatma Gandhi has begun to get a shape.

The Prime Minister has helped to spread the message of Swachh Bharat by urging people through his words and action. He carried out a cleanliness

drive in Varanasi as well. He wielded a spade near River Ganga at Assi Ghat in Varanasi under the Clean India Mission. He was joined by a large group of local people who cooperated in the Swachh Abhiyan. Understanding the significance of sanitation, Prime Minister, Shri Narendra Modi has simultaneously addressed the health problems that roughly half of the Indians families have to deal with due to lack of proper toilets in their homes.

The Swachh Survekshan annual cleanliness survey was launched as per part of the Swachh Bharat Abhiyan to conduct survey on sanitation and to check the progress of SBM which evaluates the below parameters:

- Municipal solid waste, sweeping, collection and transportation.
- Municipal solid waste, processing, and disposal of solid waste
- Open defecation free and toilets
- Capacity building and eLearning
- Provision of public toilets and community toilets
- Information, education and communication, and behaviour change

5.8 "E-Parisaraa" is a project supported by the Indo-German e-waste initiative. The pilot project is to manage e-waste without causing ecological damage has been set up with the backing of the Karnataka State Pollution Control Board in Bangalore city. Most software firms in Bangalore city have agreements with E-Parisaraa to collect their e-waste. E-Parisaraa pays these firms for the e-waste and brings it to their processing facility. What makes E-Parisaraa different is that unlike the backyard handling of e-waste, there is no melting involved in the sorting. The waste enters the disassembly-line process where it is dismantled and sorted in plastics, rubber and metal sheets. The leftover printed circuit boards and glass items such as tube lights and picture tubes go to the next stage where they are then cut into strips and powdered.

5.9 Processes used by E-Parisaraa are as follows:

- Manual Dismantling
- Hands on Segregation
- Shredding and Density Separation
- Toner Cartridge Dismantling
- Gold recovery from printed circuit boards strips and components

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- Silver recovery from silver coated components.
- Circuit for reusing fused CFLs.
- Printed circuit boards are shredded to 1.5" x 1.5" size and exported to Belgium for smelting.

5.10 The waste from electronic equipment are converted into raw materials like Metals, Plastics and Glass. The entire system of recycling is based on the principles of clean environment. The benchmark of recycling is to recycle e-waste to about 99% and 1% hazardous materials which cannot be further recycled or reused goes for scientific and secure landfill to adjacent treatment and disposal plant. The central government has passed various laws and regulations in regard to waste management. In line with these laws, state government has framed policy on integrated solid waste management.

5.11 The Waste to Wealth initiative was launched with the objective of identify and implement technologies in treating to convert to energy, recycle and extract resources. The vision of the Waste to Wealth Initiative is to identify and support the upcoming and to introduce the developing technologies in waste management, to help in spreading the objectives of Swachh Bharat Mission and Smart Cities project and to help in waste handling in the country.

Environment (Protection) Rules, 1986

5.12 Regulatory compliances to be followed for Hazardous and Other Wastes management are given below:

Rule No.	Requirement
Schedule I, Entry 94	Ensure that: (i) the exhaust muffler with an insertion loss of 25 dB(A) to the Diesel Generator (DG) is provided by the manufacturer. (ii) Acoustic enclosure is provided by the manufacturer with an insertion loss of minimum 25 dB(A) in an acoustic room before operation of the Diesel Generator (DG) sets. (iii) Ensure that the stack height above the roof of the building in which DG set is installed is as per the formula mentioned.
Schedule I,	Ensure to comply with the emission limits and noise limits as

Laws and Regulations in India

Rule No.	Requirement
Entry 95C	per the log sheet attached.
Rule 3 (1)	Ensure that the standards for emission or discharge of environmental pollutants from the industries, operations or processes shall be as specified in Schedule I to IV.
Rule 14	Submit an environmental statement for the financial year ending on the 31 st of March in Form V to the concerned State Pollution Control Board on or before the thirtieth day of September every year, beginning from 1993.

Chapter 6

Industry-wise Analysis

6.1 Waste is generated in every industry and is considered as an unavoidable by-product of economic activity. Waste is generated from inefficient production processes, low durability of goods and unsustainable consumption patterns. The generation of waste reflects a loss of material and energy and imposes economic and environmental costs on society for its collection, treatment, and disposal. The impact of waste on the environment, resources and human health depends on its quantity and nature. The generation of waste include emissions to air (including greenhouse gases), water and soil, all with potential impacts on human health and nature. Such waste generated needs to be managed systematically through assessment of potential hazards, disposal, and proper utilisation of waste so generated.

Even though waste is generated in every industry, limited but important industries with a huge impact on environment have been considered for the purpose of this guide. The industries covered in the guide are mining industry, iron and steel industry, garment industry, automobile industry and Construction industry. The importance of other industry not covered in this guide is in no way under estimated.

Mining Industry

6.2 In mining industry, wastes are generated in every stage of the operations. The types of waste generated from both the industries are solid, liquid and gaseous wastes. Waste from the mining or extractive operations (i.e., waste from extraction and processing of mineral resources) is one of the largest waste streams in the world. It involves materials that must be removed to gain access to the mineral resource, such as topsoil, overburden, and waste rock, as well as tailings remaining after minerals have been largely extracted from the mine.

6.3 Mining waste from the exploration and removal of the minerals cast challenges for many local inhabitants. Mining extraction and beneficiation can create environment problems including acid mine drainage, erosion and sedimentation, chemical release, fugitive dust emission, habitat destruction, surface and ground water contamination, and subsidence.

The waste generated can be utilized or can be reused as raw material for other processes, if not, the same has to be disposed safely so that it will not affect the environment.

Mining Waste Disposal Techniques are Terrestrial Impoundments (Tailing Ponds); Underground Backfilling; Deep Water Disposal (lakes and sea) and Recycling.

Iron and Steel Industry

6.4 Iron and steel industry characteristically is a heavy industry. All its raw materials are heavy and colossal. They encompass iron-ore, coking coal and limestone. Location of this industry is thus governed by its proximity to raw materials, predominantly coking coal.

Steel production at an integrated steel plant involves three basic steps.

- (i) The heat source used to melt iron ore is produced i.e., coke making.
- (ii) Next, the iron ore is melted in a furnace.
- (iii) Finally, the molten iron is processed to produce steel.

These three steps can be done at one facility; however, the fuel source is often purchased from off-site producers.

6.5 The operations in an integrated steel plant are very complex. Several other activities such as, power generation and production of refractories are also performed in varying degree inside the steel works. A vast quantity of raw material is handled and processed, and solid wastes are generated at every stage of operation. These wastes have wide ranging impact on the environment. These solid wastes contain valuable material which can be recovered and recycled in the process.

Carbon di oxide emissions is the major pollutant concerning the Iron and Steel Industry. It is important for this industry to adopt and implement clean technologies which help in reducing the carbon emissions.

Production of steel involves several operations. It starts from the naturally occurring raw material like, iron ore, coal and flux stones to produce hot metal in blast furnace, conversion of hot metal into steel and the subsequent rolling of steel in finished product in the rolling mills. Several other activities such as, power generation and production of refractories are also performed in varying degree inside the steel works. Large quantities of wastes are generated in

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view of the above activities. These wastes have wide ranging impacts on the environment. These solid wastes are classified into three basic categories:

- (i) Wastes which are hazardous and must be treated suitably before discarding them as waste.
- (ii) Wastes which are not hazardous, recovery, recycle and reuse of valuables in it could be done economically.
- (iii) Wastes which are not hazardous, but recovery recycle, and reuse may not be economical.

6.6 In many cases, these solid wastes contain valuable material which can be recovered and recycled in the process. Recycling and utilization of these solid wastes through an integrated waste management has gained special significance due to several factors such as, economic advantage of the primary resources, better and cleaner environment, conservation of energy and water and compliance with the law.

The main solid waste comprises:

- (a) Blast furnace slag.
- (b) Steel making slag.
- (c) Sludge from sinter plant and blast furnace gas cleaning systems.
- (d) Dust recovered from de-dusting system.
- (e) Mill scale.
- (f) Fly ash.
- (g) Waste refractories.
- (h) Raw material spilled out of the carrying system.
- (i) Waste consumables

6.7 Major Solid waste generated in Steel Plant are as below:

Plant	Solid Waste Generated
Iron Making	Air cooled BF slag, Granulated BF slag. Desulphurization slag, Flue dust, GCP sludge, Pig iron.

Industry-wise Analysis

Plant	Solid Waste Generated
Steel Making	BOF slag, BOF sludge, Lime dust, Steel scrap.
Rolling Mills	Mill scale and Silicon steel mill sludge.
Coke Oven	Coke Breeze
Coal Chemical department	Sulphur sludge, Tar Sludge
Power generation	Fly ash, Bottom ash, clinker
Others	Used refractory, Oil refining sludge, Machine shop turning

Solid waste can be categorised as Ferruginous, Non-ferruginous and Fly Ash.

6.8 Waste Management in Steel Plant is done as follows:

Solid Waste	Liquid Waste	Gaseous Waste
<ul style="list-style-type: none"> • Solid waste generation is controlled by efficient and optimum use of raw material. • Solid wastes should be disposed properly through a proper disposal system. • New technologies should be adopted for eco-friendly solid waste disposal. • Transportation of solid waste from generation point to disposal point should be in a controlled and proper way. • Displaying the area as solid waste disposal area 	<ul style="list-style-type: none"> • All major and maximum liquid wastes should be recycled. • Monitoring of the reclaimed water drawn from the respective plants • Liquid wastes should be disposed properly through the proper and efficient disposal system. • Transportation of liquid wastes from the generation point to disposal point should be in a controlled and proper way. • Displaying the area 	<ul style="list-style-type: none"> • Recycling of dust product to the respective process. • Online monitoring of combustion products such as SO_x, CO, NO_x analyser at stack dust emission level. • Monitoring ESP efficiency and stack volume. • Measuring and monitoring of ambient air quality.

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Solid Waste	Liquid Waste	Gaseous Waste
<ul style="list-style-type: none"> If possible, selling some of the solid wastes to be further used in some other ways converting waste into wealth. 	<ul style="list-style-type: none"> as liquid waste disposal area. Selling some of the liquid waste to be used in beneficial ways. 	

Garment Industry

6.9 Waste is generated at various stage in Garment Industry. Such wastes are considered as normal loss in the business. Some of them are as follows:

- Fabric Store - Inspection of the incoming fabric is very important. The fabric which is sourced from outside into the fabric store should be inspected for defects.
- Cutting Room –Sources for waste generation in cutting room can be from incorrect marking, roll remnants, etc
- Bundling Room – if the inspection is not 100%, some defective pieces go undetected and reach the stage of production.
- Production Floor – The loaders load the line with the bundles which pass on the line according to the operation. The operator may find the piece defective at any stage and dispose it off then and there.
- Dyeing and Washing – The wastage happens when the pieces are misplaced or lost during the transportation to dyeing unit. Similarly, incorrect dyeing can also lead to wastage.
- Printing/ Embroidery – The printing on the garment does not match the standard while in the case of embroidery it may not be the correct place on the garment, or the number of threads uses are less and desired effect is not obtained.
- Sample Production – Mistake in design communication; craftsman ship problem may lead to wastage.
- Finishing Department – Fitting/ measurement problem will lead to garment wastage.

Waste management in Garment Industry is undertaken by establishing a process wherein the focus is on finishing in time, minimum changes in original design, least rework, optimising usage of materials, enhancing labour productivity through training, etc.

Automotive Industries

6.10 Automotive Industry generates various wastes like metal, solvents, used oils, batteries, plastic, glass, waste cloths, cleaners, lead wheel weights, automotive chemicals, packaging materials, electronic parts, tires, etc.

Used Oil has been classified as hazardous wastes by the Ministry of Environment and Forests, Government of India which demands its proper management to avoid serious threat to the environment and for economic gains. Used oil could be recovered or reprocessed and reused as base oil thus, saving the use of virgin oil.

Used oil means any oil derived from crude oil or mixtures containing synthetic oil including used engine oil, gear oil, hydraulic oil, turbine oil, compressor oil, industrial gear oil, heat transfer oil, transformer oil, spent oil and their tank bottom sludge and suitable for re-refining.

6.11 Used oil dumped on the ground, sewers or sent to landfills is capable of seeping into ground and surface water. Just one litre of used oil can render one million litres of water undrinkable (NUOMAC, 2004). It is also a serious threat to plant and animal life. Marine species can be adversely affected by oil concentrations as low as one ppm. The oil film on water blocks sunlight thereby, making it harder for plants to photosynthesize.

6.12 The major processes that generate used oil are the machining operations such as, cutting and drilling. Coolant oil and neat cutting oil are the major contributors to the used oil generation in these processes. Used compressor oil and hydraulic oil also contribute to the used oil generation. This oil used in the machining operations is reused within the same process several times (for a period of about 3 - 6 months) before being disposed.

All the industries send the used oil from their premises to registered recyclers as per the legal requirements. A portion (about 5–10%) of the used oil is occasionally sent to construction industries for use as shuttering oil. To which recycler the used oil is sent from the industry depends upon the price quoted by the recycler which varies between Rs 6.25 to Rs15 per litre of used oil.

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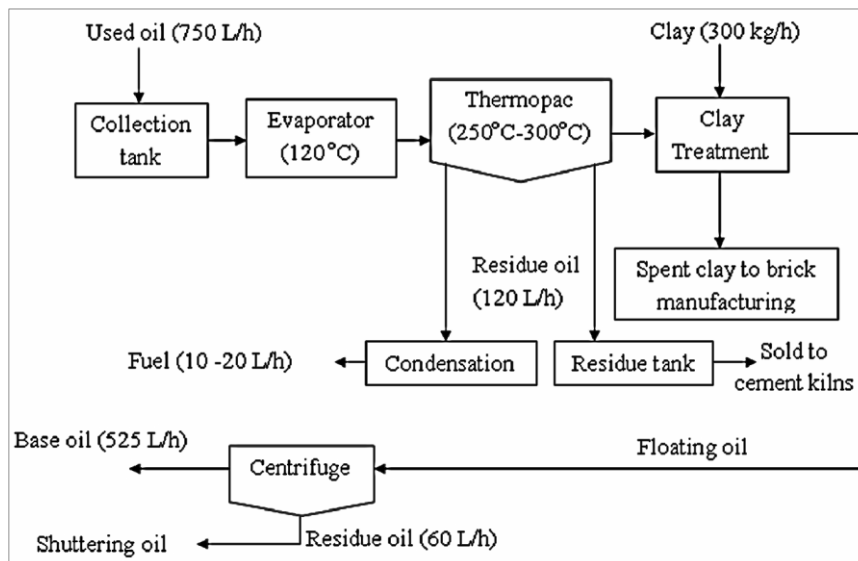
6.13 The sources for used oil generation are:

Fuel Injection Pumps; Injector Nozzle; Piston (for both diesel and petrol engine); Rings used in piston; Leaf spring; Steering assembly; Brake Assembly.

Methods to effectively manage the used oil generation and reduce used oil generation are as follows:

- Equipment scheduling adjustment
- Practice good housekeeping
- Assign coolant management to one person.
- Maintain inventory control.

6.14 The following is used oil re-refining chart:



The re-refining of used oil can help in reusing the oil for industrial use.

Tyres

Vehicle tyres have life cycle. When it is worn out, recyclers will help to reuse the tyres. When the recycled tyre is no longer suitable for use on vehicle due to its condition, it can be sent for recycling. Further burning of tyre creates air pollution and it poses huge threat to environment.

In some cases, the tyres are being used as fuel for cement manufacturing. Further in some other cases tyres are used for making asphalt road beds.

Tyres cannot be land filled, since it consumes more space. Further it creates toxic chemicals when land dumped and it will pose a serious threat.

Battery wastes

Now-a-days, the electric vehicle manufacturing has increased due to its heavy demand. Due to increase in petrol prices and air pollution created by the traditional internal combustion engines, there is a rise in electric vehicles.

Though electric vehicles reduce the air pollution and combats the increase in fuel prices, the sad part of it is the Battery wastes.

Battery has a specific life span, once the life of battery is over, it has to be scrapped. The battery wastes are hazardous in nature. Hence due care should be taken to treat this.

Most of the components of battery have a value. It can be recovered or reused. The Government has notified Battery Waste Management Rules, 2022. Every entity needs to comply with the rules mentioned here.

Given below is a list of Sustainability Standards / codes / labels adhered by the top Automotive players in the industry:

- Recyclability symbol on the Plastic parts as per ISO 11469
- Battery disposal instructions
- RoHS compliance on the premium products
- Reusability, Recyclability and Recoverability (RRR) rate values calculation (recoverability rate between 90%~95%) as per ISO 22628
- International standards for hazardous chemicals restriction (AIS 129, Directives 2011/65/EC, EC 1907/2006, 2000/53/EC).
- Compliance with Central Motor Vehicles Rules (1989), Applicable Automotive Industry Standards (AIS), Bureau of Indian Standards (BIS) and International Standards for raw material.
- FAME II Label

Construction Industry

6.15 Construction covers the processes involved in delivering buildings, infrastructure, industrial facilities and associated activities through to the end of their life. It typically starts with planning, financing, design, and continues until the asset is built and made ready for use; construction also covers repairs and maintenance work, any works to expand, extend and improve the asset, and its eventual demolition, dismantling or decommissioning.

6.16 Construction waste or debris is a kind of debris from the construction process. Environmental Protection Agency has categorized Construction and Demolition (C&D) waste into three categories: non-dangerous, hazardous, and semi-hazardous.

When waste is created, options of disposal include exportation to a landfill, incineration, direct site reuse through integration into construction or as fill dirt, and recycling for a new use if applicable. In dealing with construction and demolition waste products, it is often hard to recycle and repurpose because of the cost of processing. Businesses recycling materials must compete with often the low cost of landfills and new construction commodities.

Recycling, Disposal and Environmental Impact

6.17 Recycling, disposal and environmental impact of construction industry is as follows:

Recycling and reuse of material

Most guidelines on C&D waste management follows the waste managing hierarchy framework. This framework involves a set of alternatives for dealing with waste arranged in descending order of preference. The waste hierarchy is a nationally and internationally accepted concept used to priorities and guide efforts to manage waste. Under Waste Hierarchy, there is the concept of the "3R's," often known as "reduce, reuse, recycle." Alternatives include prevention, energy recovery, (treatment) and disposal.

It is possible to recycle many elements of construction waste. Often roll-off containers are used to transport the waste. Rubble can be crushed and reused in construction projects. Waste wood can also be recovered and recycled.

Landfilling

Certain components of construction waste such as plasterboard are hazardous once landfilled. Plasterboard is broken down in landfill conditions releasing hydrogen sulphide, a toxic gas. Once broken down, Plasterboard poses a threat of increasing Arsenic concentration Levels in its toxic inorganic form. The traditional disposal for construction waste is to send it to landfill sites. Sending the waste directly to a landfill causes following problems:

- Waste of natural resources
- Increases construction cost, especially the transportation process.
- Occupies a large area of land.
- Reduces soil quality.
- Causes water pollution (Leachate)
- Causes air pollution.
- Produces security risks, etc.

Incineration and health risks

Where recycling is not an option, the disposal of construction waste and hazardous materials must be carried out according to laws and regulations framed by relevant councils and regulatory bodies. The penalties for improper disposal of construction waste and hazardous waste, including asbestos, can be very expensive for businesses and individuals. Waste-to-energy facilities burn more than 13% of solid municipal waste. The toxic fumes emitted by WTE plants can contain harmful chemicals such as mercury and other heavy metals, carbon monoxide, sulphur dioxide, and dioxins. Dioxins have been proven to cause cancer, reproductive and developmental issues, and immune system damage. Rates of cancer such as non-Hodgkin's lymphoma and soft tissue sarcoma rise significantly the closer one lives to the pollutants' source.

6.18 Efficient use of waste in construction will help make the best use of resources. This can be achieved through on-site management, reuse of materials and through maximising the use of recycled content.

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Key issues for on-site management are:

- On site waste material segregation to aid recovery.
- Refurbishment and re-use of existing materials and infrastructure.
- Crushing and recycling of demolition waste on site.
- Over-ordering of materials to be avoided.

Key issues to maximise the use of recycled content are:

- Materials and products with good levels of recycled content to be selected.
- Minimise the use and wastage of materials through efficient design.
- Use of renewable resources from legal and sustainable sources (such as timber).

Chapter 7

Risks and Challenges

7.1 Since waste management involves collection, transportation, disposal of waste collected the entities in this industry face lots of challenges like, unavailability of land, improper infrastructure facilities, inadequate training and facilities provided to employees, no proper policy with set goal, etc.

The internal auditor should make a risk assessment of the entity under audit. This is extremely important on account of prevention of any non-compliance or undesirable event. Given below, is a brief of the different risks faced by the entity operating in the Waste Management Industry.

7.2 The internal auditor needs to verify whether sufficient controls are available in the entity to detect such risks and prevent them from happening in light of the overall business environment.

The risks faced by the Waste Management Industry can be broadly classified as follows:

- (i) Business risk
- (ii) Political risk
- (iii) Inventory management risk
- (iv) Environment risk
- (v) Brand / Reputation risk
- (vi) Systemic risk
- (vii) Technology and data security risk
- (viii) Business continuation risk

The Internal Auditor may also refer to various Technical Guides on Risk Management as issued by the ICAI.

Business Risk

Commingled waste

7.3 Often the waste is not segregated at the collection stage. This poses a big risk to the Waste management companies. All kinds of waste like, wet waste, solid waste, hazardous waste and etc are collected without being segregated at the source. In the case of Commingled waste, there are high chances of cross contamination which may impact the recyclability of other wastes.

The quality of material extracted for recycling will be deteriorated due to combination. Ideally the items which are recyclable should be collected separately. The recyclable recovery rate will be low on account of combination.

Waste Recycling is Expensive

7.4 Though recent years have seen an increase in the number of waste recycling facilities the economics of recycling is still not very favourable. In many cases recycling waste is expensive compared to buying the product. Government support in terms of cheaper land for landfills, and subsidies is often necessary for commercial viability.

Under Developed Market for Recycled Products

7.5 Insufficient demand for recycled products in the local market is another reason, which has hampered the growth of the waste recycling industry. There are a few units engaged in recycling wastepaper, paperboard, and plastics. Much of the recycled products are then exported to markets like, India, Pakistan, and other Southeast Asian countries.

7.6 The major challenges in the village environment are:

- Lack of responsibility, action and applied resources by local Panchayats who are legally responsible for providing for the collection, storage, and disposal of waste in the villages.
- Lack of waste disposal infrastructure.
- Widespread practice of keeping private spaces very clean but using public spaces as dumping areas for waste.

Risks and Challenges

- Perceptions that waste management work is of low value and low status, and therefore is not a priority.
- Organic wastes used in fields are often contaminated with plastics, hazardous wastes such as, dry cell batteries, and medical wastes.
- Limited awareness that there is a solid waste problem, and general apathy towards making positive changes.
- Lack of idea initiation or ownership within the village.
- Lack of adequate maintenance leading to overflowing bins. Lack of a disposal facility where waste can be buried.
- Lack of an adequate public education campaign.

While these problems are common to most parts of India, Government resources to provide solutions are usually directed to urban environments, where higher population densities and rapid urbanisation creates more urgent situations.

7.7 Rural areas receive little attention, despite the reality that approximately 75% of Indians are living in rural village environments. Apart from the above business risks specific to the waste management industry, the following are general business risk which an entity has to face -

- (i) A change in the legal environment that imposes new conditions, costs or restrictions upon the manner of providing the services, the means by which the services are delivered to the customer.
- (ii) A change in the volume of transactions, either to
 - Increase (requiring additional hiring and perhaps a change in business process); or
 - Decrease (resulting in sub-optimization of dedicated resources or reallocation of resources).
- (iii) Unprecedented increase in the cost of real estate leading to increased cost of operations and strain on the profitability.
- (iv) Increase in workers' compensation cost and retention of key employees.
- (v) Risks on account of non-compliance with statutes.

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- (vi) Changing importance for locations might have a significant impact taking into consideration the initial investment required to be made at every location and higher rentals that might be paid for them in comparison to the others in the vicinity.
- (vii) Credit risks related to commercial business consumers.
- (viii) Timely availability of information to enable decision making at the right time.
- (ix) Risks due to fraud and theft and impact of crime committed in the location of the entity by miscreants.
- (x) Risks due to acts of God such as earthquake, flood, windstorms, etc.

Political Risk

7.8 Political risk represents the degree to which social and governmental environments may change in the future. This risk generally manifests itself in the form of public pressure to issue stringent laws and regulations over waste management and the manner in which waste is impacting the clean air, general environment and health of citizens.

The possibility of local authority or state government not sanctioning the location which is needed for disposing off the waste resulting in deference of disposal of the waste or overusing the existing location's capacity.

Waste Management Stock Volatility

7.9 The quantum of waste collection is not uniform throughout the year. Often there is an increase and decrease inventory levels. Due to this some part of the year, there will be very less inventory for processing the waste. When the waste inventories are less, the revenue generation for the company goes down but the fixed cost remain the same due to which the waste management company may incur losses.

On some occasions the waste inventories are too high and there is no sufficient space to store them for processing in near future. Further when the waste inventory levels are high there are high chances of recyclable waste getting deteriorated while storing them. This could lead to loss for the waste management company.

All these factors will impact the smooth processing of waste due to varying levels of inventory further it also impacts the profitability of business.

Environment Risk

7.10 Industrial wastes when not disposed of in a safe manner can pose a threat to the environment by contaminating the air, water, and soil. Environmental risks associated with the waste management industry generally fall into one of the following three categories:

- (i) Site acquisition, development, and construction – Considering that waste management entities buy and develop property to suit the infrastructural requirement of the business; the entity should develop an effective due diligence process and manage environmental risk. The significant cost would be on account of:
 - **Clean-up Cost Cap** for “capping” the cost of cleaning up known pollution conditions.
 - **Legal Liability** for transferring the risk of cleaning up unknown pre-existing pollution conditions, third-party claims, and other related exposures
 - Loss of Income due to **delay in opening** / scheduled completion of the project.

Brand/ Reputation Risk

7.11 Enterprise viability depends on maintaining the goodwill of the enterprise brand. Damage to reputation may never be recovered or may only be recovered at great expense and distraction. Reputational risk is significant in a waste management industry.

Brand risk management techniques include the use of scripts, supervision, random audits, ongoing training, and customer feedback. Legal issues in reputational risk can arise where the enterprise customer wishes to terminate a service provider, redirect its efforts or adjust the pricing to reflect a loss of goodwill.

Technology Risk

7.12 Technology risk refers to the risk that an entity faces due to changes in technology or obsolescence of existing technology. In the event of changes in technology, the investments made by the entity becomes obsolete or inefficient. Technology could be in the form of purchase/ creation of software or hardware. It is important for waste management companies to adopt and

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implement clean technologies which help in reducing the carbon emissions, proper recycling of specific wastes and reduce the ill effects on the environment due to improper disposal of waste, not keeping up to the fast paced and changing technologies can also pose as a risk in the waste management sector.

Business Continuance Risk

7.13 The major risks which affect the business continuance would include improper supply chain management, timely availability of financing and funding (cash flow), damage of brand and significant changes in economic situations. The entity must be prepared to mitigate these risks and ensure successful carrying of business.

Manufacturing Risk

7.14 The manufacturing risks can arise due to operational inefficiencies, non-compliance to Standards on Environment, Health and Safety (EHS), Incorrect cost records and GST records.

Supply chain interruptions is major concern for Waste Management companies. Many a times the supply chain workers go for a strike. This impacts the supply chain to a great extent. Old trucks and vehicles are used for collection of waste. There may be vehicle breakdowns, this may again interrupt the supply chain.

Employee injuries, most of the times the waste collected are not segregated and there may be sharp objects, hazardous objects, infectious wastes found in the wastes. So, there is a high risk that the employees may get injured. These events may adversely impact the smooth manufacturing of the company.

Volatility in raw waste price- The price of raw waste has significant impact on the manufacturing companies. A spike in the raw waste price may bring a temporary pause of waste manufacturing. This will have adverse impact on profitability of the Company.

Non-compliance to Standards on Environment Health and Safety has direct impact on the manufacturing. The rules are very strict in India, and non-compliance may also lead to seizure of Manufacturing premises. So, the company needs to comply with these rules very diligently, if not, it will have impact on the manufacturing.

Risks Mitigation Techniques

7.15 An illustrative list of risks mitigation techniques that the management might opt for would include the following:

- In the current environment, the entity should have complete knowledge about those risks and consider all pitfalls, understand the exposures, and develop risk management practices and programs that address this evolving exposure.
- Prioritizing the risks, creating a plan to strategically manage the risks, implementing the plan as necessary, and monitoring the plan's implementation for evaluation and improvement purposes.
- Certain risks such as, frauds, environmental damage might be reduced through visual inspections, carrying on surprise checks and verification, etc.
- It might be appropriate for the entity to have a comprehensive insurance policy to cover significant part of risks.
- Training of employees in inventory handling, especially in the case of managing open/ broken bags, containers, perishable and sensitive products.
- Proper store maintenance procedure should be implemented.
- A risk identification system would be required to be installed. Further, the Management Information System (MIS) should provide for certain yardsticks which would enable the management to identify the critical risks and its impact on the entity.
- Indemnity clauses with suppliers and external vendors would ensure that any loss arising due to suppliers and external vendors would be indemnified.

The Internal auditor may be required to make a complete assessment of enterprise risks and provide an insight on methods of mitigation of risks. Internal auditor might prepare a questionnaire or a checklist for this purpose.

Opportunities

7.16 In last few years, planning authorities have awarded a number of contracts to the private sector for setting up and operating Integrated Waste Management Facilities or waste recycling units. However, opportunities in the sector are still largely untapped. The following are some major areas for exploration:

(i) Waste Collection and Transportation Services– A number of private players are active in the waste collection and transportation market. At present, around 70 percent of the total waste in Dubai is collected by private sector. There is good growth potential for such services in the market.

(ii) Management of Landfill Operations– At present, municipalities manage the majority of the landfills; however, it is likely that new facilities would be built under BOOT or BOT contracts. In fact, Singapore-based Keppel Corporation is setting up an integrated waste management facility in Qatar. Once the facility is operational, the company will also be responsible for its operations and maintenance for 20 years.

(iii) Waste Recycling– Recycling of wastepaper, paper board, metals and glass is already practiced in GCC albeit at very small scale. Currently, around 80 percent of the total waste generated is sent to landfills, which is high as per international standards. With only 20 percent of the total waste being recycled, recycling is set to increase. As waste management practices become more efficient across the region, waste recycling is likely to be more attractive commercially.

(iv) Waste to energy opportunity– Planning authorities across the region are contemplating setting up waste to energy facilities. The market for such technologies is likely to see rapid growth over next few years.

(v) Equipment Suppliers– Increased focus on waste management represents a growing market for suppliers of compactor trucks, garbage bins, incinerators, and other auxiliary equipment.

As countries work towards the implementation of next generation waste management practices to address challenges of global warming, environmental preservation and sustainability, the waste management market is set to enter an exciting phase. Recent amendments to various laws and strict compliance to these laws help to make the world a better place to live.

Chapter 8

Need for Internal Audit

8.1 Considering the nature of the Waste Management Industry and the pace at which the industry has grown over the past decade, the need for ensuring proper controls need not be over-emphasized. Indian waste management industry is one of the industries which require lots of attention especially with environmental hazards created due to overuse of resources, improper disposal mechanism, especially over the last few years. Though the waste management industry in India is mostly unorganized, the governments both central and state have taken significant initiatives in encouraging this sector to be more organised given the importance of speed of operations required in waste management industry.

8.2 With increasing volume of wastes generated and considering the vulnerability of the sector to modification of environment and slowness in adopting to the change, internal audit becomes significant. Internal audit also helps in verifying the controls in place within the entity with regard to sufficiency and effectiveness in light of overall business of managing the waste generated or collected and in complying with various laws in force in this regard. Internal audit also helps in assessing the risks faced by the entity and provide a method for mitigating the same. Internal controls and risk management are extremely important activities in an entity operating in the waste management Industry.

8.3 Effective internal audit provides an effective tool to simplify complexities, help ensure that systems and processes are adequate to support the growth and evolve with the changes in various regulations, thereby ensuring sustained growth and development.

Internal Audit provides an effective tool to ease out all complexities, ensures that systems and processes are adequate to support the growth and are adapted to the changes in various regulations, thereby ensuring sustained growth and development.

As defined in Framework Governing Internal Audits, "Internal Audit provides independent assurance on the effectiveness of internal controls and risk management processes to enhance governance and achieve organizational objectives."

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Brief explanation of the key terms used above is as follows:

- i) Independence: Internal audit shall be an independent function, achieved through the position, organization structure and reporting of the internal auditor. At times, in addition to providing assurance, the internal auditor may adopt an advisory role to help an organization achieve its objectives, provided this does not compromise the independence of the internal auditor.
- ii) Internal controls and risk management are integral parts of management function and business operations. An internal auditor is expected to evaluate the design and operating effectiveness of internal controls and risk management processes (including reporting processes) as designed and implemented by the management.
- iii) Governance is a set of relationships between the company and its various stakeholders and provides the structure through which the company's objectives are achieved. It includes compliance with internal policies and procedures and laws and regulation.
- iv) Organizational objectives incorporate the interests of all stakeholders and include the short- and medium-term goals that an organization seeks to accomplish.

Factors Contributing to the Evolution of Internal Audit

8.4 General Guidelines on Internal Audit issued by the Institute of Chartered Accountants of India describes the factors contributing the evolution of Internal Audit in India. A few such factors are as follows:

(i) Increased size and complexity of businesses

Increased size and business spread dilutes direct management oversight on various functions, necessitating the need for a full time, independent and dedicated team to review and appraise operations. Complexity of operations results in requirement of specialists in the field to guide the management.

(ii) Enhanced compliance requirements

Increase in the geographical spread of the businesses has also led to crossing of political frontiers by businesses in a bid to tap global capital for improving the technology. This has thrown up compliance with the laws of the

home country as well as the laws of that land as a critical factor for existence of businesses abroad.

(iii) Focus on risk management and internal controls to manage them

Internal auditors can carry out their job in a more focused manner by directing their efforts in the areas where there is a greater risk, thereby enhancing the overall efficiency of the process and adding greater value with the same set of resources.

(iv) Stringent norms mandated by regulators to protect investors

The regulators are coming up in a big way to protect the interests of the investors. The focus of the latest regulations being ethical conduct of business, enhanced corporate governance and reporting requirements to various Boards and committees.

(v) Unconventional business models

Businesses today use unconventional models and practices, for example, outsourcing of non-core areas, such as, collection of waste generated to another organization rather than dealing with on its own.

(vi) An increasingly competitive environment

Whereas deregulation and globalization have melted the political as well as other barriers to entry in the markets for goods and services, free flow of capital, technology and know-how among the countries as well as strong infrastructure has helped in providing better access to the existing best practices globally and technology and equipment to carry on the business smoothly. This in turn, has lured more and more players in the existing markets, thereby, stiffening the competition.

(vii) Intensive use of Information Technology

Information technology (IT) is invariably embedded in all spheres of activities of a modern business enterprise today, from data processing to resource planning to online sales and e-commerce. Use of IT has, however, increased the threat of data thefts or losses on account of systems failure or hacking/espionage, as well as the need to comply with the cyber laws, etc

(viii) Need for internal audit to provide demonstrable value addition

Over the years, better corporate governance practices complemented by enhanced accounting and disclosure policies and practices codified in the form of Accounting Standards as well as immaculately designed advanced

software packages for accounting and resource planning, have considerably brought down the need for the management to act as a police over the reliability and accuracy of the financial data. The internal audit has to, therefore focus, on areas other than financial data as well and help increase the stakeholders' value. One such focus area could be identifying areas of wastage of physical resources, deficiencies in internal controls, etc.

Standards on Internal Audit

8.5 Internal auditor should carefully go through Standards on Internal Audit (SIAs) issued by ICAI. Standards on Internal Audit (SIA) is recommendatory in nature for the initial period. These Standards shall become mandatory on such date as notified by the Council of the ICAI.

These Standards have been classified and renumbered as follows:

- (i) 100 Series: Standards on Key Concepts
- (ii) 200 Series: Standards on Internal Audit Management
- (iii) 300-400 Series: Standards on Conduct of Audit Assignments
- (iv) 500 Series: Standards on Specialized Areas
- (v) 600 Series: Standards on Quality Control
- (vi) 700 Series: Other/Miscellaneous Matters
- (vii) Standards issued up to July 1, 2013

100 Series: Standards on Key Concepts

SIA 110: Nature of Assurance

SIA 120: Internal Controls

SIA 130: Risk Management

SIA 140: Governance

SIA 150: Compliance with Laws and Regulations

200 Series: Standards on Internal Audit Management

SIA 210: Managing the Internal Audit Function

SIA 220: Conducting Overall Internal Audit Planning

SIA 230: Objectives of Internal Audit

SIA 240: Using the Work of an Expert

SIA 250: Communication with Those Charged with Governance

300–400: Series: Standards on the Conduct of Audit Assignments

SIA 310: Planning the Internal Audit Assignment

SIA 320: Internal Audit Evidence

SIA 330: Internal Audit Documentation

SIA 350: Review and Supervision of Audit Assignments

SIA 360: Communication with Management

SIA 370: Reporting Results

SIA 390: Monitoring and Reporting of Prior Audit Issues

500 Series: Standards on Specialised Areas

SIA 520: Internal Auditing in an Information Technology Environment

SIA 530: Third Party Service Provider

The Standards issued up to July 1, 2013

SIA 5: Sampling

SIA 6: Analytical Procedures

SIA 7: Quality Assurance in Internal Audit

SIA 11: Consideration of Fraud in an Internal Audit

SIA 18: Related Parties

Internal Control

8.6 SIA 120 “Internal Controls” states that Internal Controls are systemic and procedural steps adopted by an organisation to mitigate risks, primarily in the areas of financial accounting and reporting, operational processing and compliance with laws and regulations.

Internal Controls (ICs) are essentially risk mitigation steps taken to strengthen the organization’s systems and processes, as well as help to prevent and detect errors and irregularities.

The actual steps of mitigation (e.g., review, approval, physical count, segregation of duty, etc.) are referred to as “Control Activities”. When ICs mitigate the risk of financial exposure, they are also referred to as Internal Financial Controls (IFCs) and when they mitigate operational risks, they are

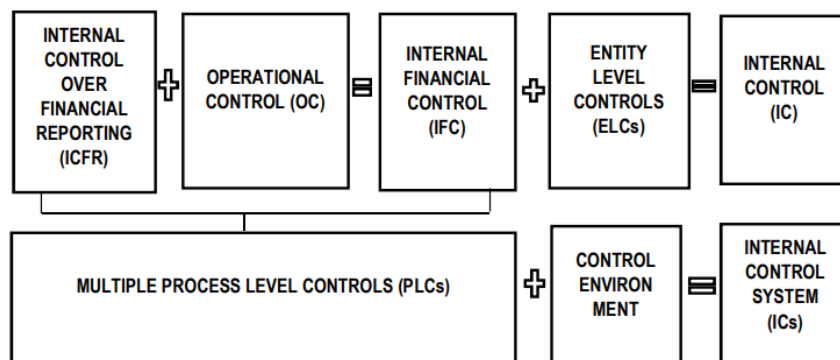
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also referred to as Operational Controls (OCs). ICs generally operate with human intervention (Manual Controls), but in an automated environment, computer controls are deployed to secure the systems and called IT General Controls (e.g., access controls) or check transaction processing at an application level and called Application Controls (e.g., sequential numbering of invoices, etc.).

The term “Internal Controls System” is an all-encompassing term generally used to refer all types of controls put together, covering ELCs, IFCs and OCs. The Control Environment (ELCs) includes the overall culture, attitude, awareness and actions of Board of Directors and management regarding the internal controls and their importance to the organization. The control environment has an influence on the effectiveness of the overall Internal Control System since it provides the basis for establishing and operating process level controls (such as IFC and OCs) in the organization.

The internal auditor may obtain an understanding of the significant processes and internal control systems sufficient to plan the internal audit engagement and develop an effective audit approach. The internal auditor should use professional judgment to assess and evaluate the maturity of the entity’s internal control. The auditor should obtain an understanding of the control environment sufficient to assess management’s attitudes, awareness and actions regarding internal controls and their importance in the entity.

Below is a pictorial depiction of Internal control and Internal control systems:



Overview of Compliance

Compliance means ensuring conformity and adherence to Acts, Rules, Regulation, Directives and Circulars.

Standard on Internal Audit (SIA) 150 “Compliance with Laws and regulations” issued by Institute of Chartered Accounts of India requires that internal auditor to provide independent assurance to management and to those charged with governance on the compliance framework. The nature and extent of internal audit procedures to be applied is dependent on the framework in place and maturity of the processes.

In case the management has implemented the formal compliance framework, the internal auditor shall plan and perform internal audit procedures to evaluate the design, implementation and operating effectiveness of such framework. While auditing the compliance framework the Internal Auditor attention is invited to para 6.1 of the SIA 150, Compliance with Laws and regulations which deals with the broad areas of Auditing the Compliance Framework.

In case there is no formal compliance framework, the internal auditor shall design and conduct the audit procedures with a view to highlight any exposures arising from weak or absent compliance activities and processes, internal auditor shall make recommendations to implement and strengthen those processes and thereby, improve compliance. While auditing the Compliance Activities and Processes, the Internal Auditor attention is invited to para 6.2 of the SIA 150, Compliance with Laws and regulations which deals this topic in detail.

Where the independent assurance requires the issuance of an audit opinion over the design, implementation and operating effectiveness over compliance, this shall be undertaken in line with the requirements of SIA 110, Nature of Assurance. Also the internal auditors attention is invited to para 6.3 of the SIA 150, Compliance with Laws and Regulations to consider important areas.

Understanding of Laws and Regulations

8.7 Laws and regulation vary considerably in their relation to the financial statements. Some laws or regulations determine the form or content of an entity’s financial statement or the amount to be recorded or disclosures to be made in financial statements. Other laws or regulation are to be complied with by management or prescribe the provisions under which the entity is allowed to conduct its business. Non-compliance with laws and regulation could result in financial consequences for the entity such as fines, litigation, etc. It also has a potential effect on going concern as an entity. The internal auditor should plan and perform the audit recognizing that the audit may

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reveal conditions or events that would lead to questioning whether an entity is complying with laws and regulations.

8.8 In order to plan the audit, the internal auditor should obtain an understanding of the legal and regulatory framework applicable to the entity and how the entity is complying with that framework. To obtain this understanding, the internal auditor would particularly recognize that noncompliance of some laws and regulations may have a fundamental effect on the operations of the entity and may even cause the entity to cease operations or call into question the entity's continuance as going concern. To obtain an understanding of laws and regulations, the internal auditor would ordinarily:

- Use the existing knowledge of the entity's industry and business.
- Inquire with management as to the laws or regulations that may be expected to have a fundamental effect on the operations of the entity.
- Inquire with management concerning the entity's policies and procedures regarding compliance with laws and regulations.
- Discuss with management the policies or procedures adopted for identifying, evaluating, and accounting for litigation claims and assessments.

After obtaining the required understanding, the internal auditor should perform procedures to identify instances of non-compliance with those laws and regulations where non-compliance should be considered while preparing financial statements, specifically:

- Inquiring with management as to whether the entity is in compliance with such laws and regulations.
- Inspecting correspondence with the relevant licensing or regulatory authorities.

Significance of Compliance

8.9 The significance of compliance is as follows:

- (a) The benefits to the industry:
- Helps in compliance with Legal terms and covenants and thereby reduces penalties and charges.

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- Increased Internal Control
 - Reduction of Internal Frauds and Losses
 - More time available for other core activities
 - Increases efficiency in operations.
 - Customer satisfaction
- (b) Benefits to the customers:
- Ensures safer marketplace.
 - Safeguards the customer interests.
 - Quality Assurance
 - Enhanced Consumer Protection
- (c) Benefits to the stakeholder:
- Ensures risk containment and safer marketplace.
 - Better Investor confidence
 - Uniform Practices
 - Better image, hence, better value for the investor.

As per the relevant *SIA* issued by the ICAI, when planning and performing audit procedures and in evaluating and reporting the results thereof, the internal auditor should recognize that non-compliance by the entity with relation to laws and regulations may materially affect the financial statements. However, an audit cannot be expected to detect non-compliance with all laws and regulations. Detection of non-compliance, regardless of materiality, requires consideration of the implications for the integrity of management or employees and the possible effect on other aspects of the internal audit. Thus, in addition to the various acts, rules, bye laws, regulations, circulars, pronouncements, etc., the internal auditor is required to verify some of the other applicable regulations which includes:

- (i) Governance Laws
- The Companies Act, 2013
 - Partnership Act, 1932 / Limited Liability Partnership Act, 2008
 - Shops and Establishments Act of respective states.
 - The Sale of Goods Act, 1930

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- The Negotiable Instruments Act, 1881
- The Income tax Act, 1961
- Service Tax under the Finance Act, 1994
- Goods and Service Tax Act, 2017
- The Indian Contract Act, 1872
- Land Acquisition Act, 1894

(ii) Labour Laws

- The Employees' Provident Fund and Miscellaneous Provisions Act, 1952
- Employee State Insurance Act, 1948
- Payment of Gratuity Act, 1972
- Payment of Bonus Act, 1965
- Professional Tax enacted by the respective states
- The Child Labour (Prohibition and Regulation) Act, 1986
- The Minimum Wages Act, 1948
- The Weekly Holidays Act, 1942

Apart from the above laws, the internal auditor is required to be aware of the local legislations under which the entity/ undertaking operates. For e.g., Under Karnataka Shops and Commercial Establishments Act, 1961. The act prescribes the daily and weekly hours, extra wages for overtime work, holidays for all entities established in Karnataka.

The internal auditor is required to ensure the compliance of respective state legislations too as part of his internal audit procedures.

(iii) Statutory laws applicable to Waste management Industry

- Bio-Medical Waste Management Rules, 2016
- E-Waste (Management) Rules, 2022
- Solid Waste Management Rules, 2016
- Plastic Waste Management Rules, 2022

The excerpts of the rules specific to waste management industry have already been mentioned in detail hence not covered here.

Major Areas of Internal Audit Significance

8.10 General internal audit procedures that apply to any industry also apply to an entity operating in the waste management Industry. In this technical guide, internal auditing procedures pertaining to waste management Industry have been specified. Procedures and techniques that are unique to this industry are incorporated in the Guide, and which would be required to be combined with the internal auditors' judgment, skill and experience can perform an effective internal audit.

These audit procedures are an illustrative list which can be performed in addition to the regular internal audit procedures performed by an internal auditor. Entities in waste management industry are classified primarily into two categories namely:

- (i) Entities generating waste as well as disposing it on its own;
- (ii) Entities engaged in the business of collection of waste and disposing it

Invoicing and Billing

8.11 The Invoicing process varies significantly and is directly based on the nature of customer from whom the waste is collected. To elaborate, it varies from a systematic billing process and checking process in the case of customer being a business unit to non-systematic cash-based billing in the case of customer being a domestic household or small business unit.

The billing and invoicing process in the waste management industry needs to be simple, systematic, fast, secure, and error-free to avoid unnecessary waiting time for billing processes and plays a major role in the success of the organisation. It might be pertinent to note that potential for omitted/manipulating income is greater in this industry as the recipient of cash from customers need not give a bill/ invoice in case of domestic household/ small business units. It is important for the internal auditor to check if bill books are printed and whether the amount collected matches with the number of business units/ household from whom the waste is collected.

In general, cheques are generally collected only from medium/ large business unit and approximately 75% of the collection may be in cash.

Cash Pay Outs

8.12 Accounting for cash is a primary focus for the internal auditor. Considering that cash is paid for a significant part of the billing by the entity, maintenance of proper records is a critical part of the overall organisation management. It is equally important to ensure that there is sufficient and appropriate fixing of responsibility in the case of management of cash and its complete and timely banking.

Considering the nature of industry, most of the payments that are made, including payroll charges, may be paid through cash. The employees associated may not be from high income group and opening a bank account will be a burden on the employees. There is a possibility of recording salary twice for the same employee. It is important for the internal auditor to check, if sufficient control exists in the company.

In recent times, there is a significant push towards digital payments. In 2016, the Government introduced the UPI method of payment. Receiving and paying money has become very easy using this method. The customers in the tier one cities have mostly changed to digital method now. However, still some customers make cash payments only.

Fixed Assets

8.13 If the waste management company collects and process the disposal of waste on its own accord then there is a possibility of having its own fixed assets. In such case, care needs to be taken by the auditor to check whether there is any subsidy granted by the government for procuring such assets. If yes, then the auditor needs to check the amount capitalised in the books and the related depreciation calculation.

If the company does not own any vehicle for collecting the waste and instead hired the vehicle on rent, then such rental agreement needs to be checked. The internal auditor needs to check whether periodical maintenance of equipment used for treating the waste collected or generated, vehicles used for transportation are taken up.

Point of Collection

8.14 On collection of waste from business units/ hospitals, it is important that the company provides a description of waste collected on periodical basis. This is pertinent especially regarding bio medical waste collection and disposal. The hospital is required to provide details of bio medical waste

generated and disposed during the year by January 31st of succeeding year. Further, the document prepared at the time of collection of waste will act as a basis for future reconciliation of payments received. Internal auditor needs to check whether the details are provided regularly to the generator of waste and the government department periodically.

Cash Management Policies

8.15 Efficient cash management processes are pre-requisites to execute payments, collect receivables and manage liquidity. Managing the channels of collections, payments and accounting information efficiently becomes imperative with growth in business transaction volumes. This includes enabling greater connectivity to internal corporate systems, expanding the scope of cash management services to include “full-cycle” processes (i.e., from purchase order to reconciliation). Cash management services targeted at the needs of specific customer segments. Cost optimization and value add services are customer demands that necessitate the creation of a mechanism to service the various customer groups.

8.16 Some of the Cash Management Techniques followed by Companies include the following:

- (i) Account reconciliation services– Balancing a cheque book for a very large business can be quite a difficult process. Banks have developed a system to overcome this issue. They allow companies to upload a list of all the cheques whereby at the end of the month, the bank statement will show not only the cleared cheques but also uncleared ones.
- (ii) Positive pay– It is effective anti-fraud measure for cheque disbursements. Using the cheque issuance data, updated regularly with cheque issuance and payment, the bank balances all cheques offered for payment. In the case of any discrepancies, the cheque is reported as an exception and is returned.
- (iii) Balance reporting services– Balance reporting provides help in procuring a company’s current banking information from its accounts. With this service, the banks can offer almost all types of transaction specific details.
- (iv) Cheque writing– In order to execute the payments faster, banks are providing cheque writing facility to the corporate customers wherein customer can print the cheques locally at their own office with the facility of digital signatures and company logos.

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- (v) Liquidity management– In order to have efficient utilization of excess funds corporate today avail the facility of liquidity management. Liquidity management system prudently manages various assets and liabilities (on-and off-balance sheet) and ensures that cash inflows have an appropriate relationship to the approaching size of cash outflows. The system ensures that necessary funds are available to entertain all cash outflows as they fall due.

Adequate cash management mechanisms ensure efficient collection systems, systematic disbursements, and ideal deployment of idle funds, tiding over immediate cash needs, and compensating the banks that support these activities of the company. An advanced cash management system enhances the possibilities of earning high net interest income, creates efficient balance sheets, minimizes expenses on resources, and reduces the company's exposures to potential risks related to seasonality of business and debt repayments.

8.17 Cash management processes in the waste management sector are currently in the focus as most of the transactions happen through cash. Cash continues to play a dominating role in the Waste management industry. After the ascent of the cashless payments, still more than 75 percent are cash transactions.

The internal auditor's key task of cash management is therefore, to identify the core issues in waste management sector, and to develop processes that are an optimal fit for their operations.

In order to find the most effective solution in each case, the work of an Internal Auditor is divided into the following four steps:

- *Analysis of structures and processes*– Analyse the factors such as, customers' payment habits or organization at the point of sale. This gives an exact picture of the status quo in a company store.
- *Development of solution proposals*– Parallel to this, the Waste management company's intentions, and objectives with regard to cash automation are discussed and specified. Together with the hard facts from the status quo analysis, these aspects form the basis for working on concrete solution scenarios.
- *Piloting in the store*– Recommendations involve not only the POS hardware but also include redesign and optimization of the entire cash process in a store. They include return on investment calculations,

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which, due to the current situation analysis, already contain very detailed and realistic pay-back forecasts.

- *Decision on the project*– With the experiences gained during piloting, possibly enhanced with a customer survey, the waste management company has sufficient data and facts on which to take his investment decision. This is then specified, the project is planned in detail, and the rollout scope and schedule defined.

Following are advantages of these steps:

- Potential for savings through automated end-to-end handling of the cash flow from the point of sale to the cash office and on to the cash-in-transit operator for posting at the bank.
- Considerable reduction in discrepancies (at the point of sale and between the cash centre and store) due to efficient controlling and better monitoring facilities.
- Fewer interfaces thanks to a closed cash cycle.
- Cash flow transparency with end-to-end controlling and reporting to reduce operational risk.

8.18 Model Checklist related to the Billing process is as follows:

SI. No.	PARTICULARS	Yes	No	NA
	<i>Verification of Billing Mechanism</i>			
1.1	Is there a proper billing system commensurate with the size of business?			
1.2	Have we verified the controls in place to ensure fixing of appropriate responsibility to the person? Are there sufficient systems to ensure periodic job rotation preventing misappropriation of funds?			
1.3	Are the systems inbuilt to detect any billing mistakes and errors?			
1.4	Is there any log maintained by the entity as regards errors and mistakes in billing?			
1.5	Does the entity take sufficient measures in ensuring prevention of such instances?			

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Sl. No.	PARTICULARS	Yes	No	NA
1.6	Does the entity have a proper system of collection of the amount billed?			
1.7	Is the collection made in a manner enabling smooth collection of payments apart from ensuring that there are sufficient control processes?			
1.8	Is there a routine checking of collections made at the time of change in billing personnel?			
1.9	Is the collection performed by an authorised person?			
1.10	Is the collection verified and reconciled on a daily basis and approved?			
1.11	Are the processes sufficient to ensure appropriate banking of cash and sending of coupons to the head office?			
1.12	Is there sufficient monitoring by the entity to ensure prevention and detection of fraud by persons collecting cash from household/ business units paying in cash?			
1.13	Has there been a sufficient system audit / verification performed by the internal auditor to ensure that the billing system is without any mistakes?			
1.14	Has the Internal auditor performed any statistical function in estimating the queuing system and area allocation system of the store?			

Collection of Waste and Disposal

8.19 Collection of waste is the most important activity in the waste management industry. They refer to the waste procured by the concern either for its sales or disposal. The procurement involves the process of sourcing of waste based on different categories. The collection of waste either based on

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segregation at source or segregation at the point of disposal plays a vital role in order to determine the method of disposal of waste. In certain cases, on collection of waste the entity has to pay to the generator of waste. Also, the entity has to incur cost on disposal. Sourcing can be done directly from the following sources:

- Manufacturers of waste
- Intermediaries - Wholesalers, distributors and dealers.

8.20 Considering that the total cost of waste collected accounts for around 75% of the expenditure incurred by the entity and the entity, generally, operates in a very small net margin, the importance of procurement of products at the right time and the right sources plays a significant role in ensuring the profitability of business and sustainability of business.

The internal auditor needs to verify whether the entity has evaluated each type of waste for determining the basis and process of evaluation. Further, the screening process should ensure that the vendor has ethics and has no track record of any frauds in the past.

SI. No.	PARTICULARS	Yes	No	NA
	<i>Procurement of Waste and Disposal</i>			
1.1	Does the entity have a written policy for the procurement process?			
1.2	Is the written policy sufficient and complete in all aspects?			
1.3	Is the policy updated on a frequent basis?			
1.4	Are there sufficient controls to trace the purchase of waste and its status within the entity to ensure receipt of materials without delay and to avoid any health hazard?			
1.5	Are there any contracts entered by the entity with suppliers to ensure adequate supply at a reasonable price?			
1.6	Are there sufficient procedures to inspect materials as regards to specification and quantity, received by the entity at the site before			

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SI. No.	PARTICULARS	Yes	No	NA
	unloading and signing of the delivery note?			
1.7	Are there sufficient documentary controls such as gate pass for entry of goods?			
1.8	Has a sample check for compliance of procedures performed?			
1.9	Is the process of receipt of material properly coordinated to the Finance department to ensure proper accounting?			
1.10	Does the material receiving department maintains sufficient records of receipt and inspection of material?			
1.11	Before making the entry, has the delivery note been approved by the appropriate level of authority?			
1.12	In cases where materials are supplied by client, has the internal auditor ensured that there has been appropriate accounting of such material?			
1.13	Does the entity have proper control for materials received from the client? Are they separately identified and demarcated?			
1.14	Does the entity have a process of evaluation of all the waste collected which is sufficient in the light of overall volume and size of business?			
1.15	Has the contract between suppliers made complete with all terms and conditions and have the risk been appropriately specified?			
1.16	Are there areas where we are risking more than we are saving by entering into an agreement with generator of waste?			
1.17	What would be the likely financial impact of a critical operational issue/ disruption to our operations?			

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SI. No.	PARTICULARS	Yes	No	NA
1.18	Does the entity have a system of disposal booking commensurate to the size of business?			
1.19	In the case of credit sales, does the entity have sufficient measures to book sales at the appropriate time in accordance with the terms of sale?			
1.20	What would be the likely environmental impact of a critical operational issue/ disruption to our operations?			

Supply Chain Management

8.21 Supply Chain Management (SCM) is the management of a network of interconnected businesses involved in the ultimate provision of product and service packages required by the end customers. Supply Chain Management spans all movement and storage of raw materials, work-in-process inventory, and finished goods from point of origin to point of consumption.

The supply chain function involves vendor management, quality assurance and transportation. Vendor management assumes critical importance in waste management business where one has to deal with multiple type of waste.

Supply chain management is typically viewed to lie between fully vertically integrated firms, where the entire material flow is owned by a single firm and those where each channel member operates in depend.

8.22 Six Sigma in supply chain management (SCM) helps in achieving substantial benefits in terms of costs and quality. Effective implementation of Six Sigma in supply chain management requires collection of data from multiple organizations spread across multiple geographical locations.

Six Sigma enables:

- Improvement in delivery time.
- Reduction of logistics cost.
- Lesser inventory cost.
- Improvement in the disposal mechanism of waste collected

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Supply chain management involves two broad categories i.e., strategic and operational.

8.23 As the term implies, strategic decisions are made typically over a longer time horizon. These are closely linked to the entity's strategy and guide supply chain policies from a design perspective. On the other hand, operational decisions are short term, and focus on activities over a day-today basis. The effort in these types of decisions is to effectively and efficiently manage the product flow in the "strategically" planned supply chain.

The strategy needs to include four major decision areas in Supply Chain Management:

- (i) Location
- (ii) Production
- (iii) Inventory and
- (iv) Transportation (distribution).

8.24 Typically, a supply chain management would include the following components:

(i) Distribution Network Configuration– Number, location and network missions of suppliers, production facilities, distribution centres, warehouses, cross-docks, and customers. This from the perspective of entity collecting the waste through various associate enterprises from generator of waste.

(ii) Distribution Strategy– Operating control e.g., centralized, decentralized or shared; collection scheme, e.g., direct shipment, pool point shipping, DSD (direct store delivery), closed loop shipping; mode of transportation and transportation control (e.g., owner-operated, private carrier, common carrier, contract carrier).

(iii) Trade-Offs in Logistical Activities– The above activities must be well coordinated in order to achieve the lowest total logistics cost. Trade-offs may increase the total cost if only one of the activities is optimized. It is therefore imperative to take a systems approach when planning logistical activities. This trade-off is key to developing the most efficient and effective Logistics and SCM strategy.

(iv) Inventory Management– Quantity and location of inventory, work-in progress (WIP) and finished goods. This is a major area in the waste management industry taking into consideration not only the volume of

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inventory, but also type of waste collected. Hence, the entity needs to also ensure that the material is stored at the appropriate place with sufficient infrastructure facility. To enable this, the system should be comprehensive enough to track details of all products procured from different suppliers.

(v) Cash-Flow- Arranging the payment terms and methodologies for exchanging funds across entities within the supply chain.

8.25 Internal audit functions are increasingly important as entities work to manage its increasingly complex and pervasive supply chain risk. Supplier disruption can immediately and significantly affect profitability, impair growth opportunities, shatter shareholder interest, and compromise reputation through a decreased level of public confidence.

The following procedures may be performed by the internal auditor to evaluate the supply chain management system:

SI. No.	PARTICULARS	Yes	No	NA
<i>Analysing the Supply Chain Management System</i>				
1.1	Has the entity made a comprehensive study on the supply chain?			
1.2	Is the supply chain management system commensurate with the size of business?			
1.3	Has the entity taken steps to evaluate the cost-benefit of having an in-house system vis-à-vis an external service provider?			
1.4	Are the terms of contract with the external service provider appropriate in the overall business scenario?			
1.5	Are there sufficient indemnification clauses available in the agreement to enable management of risk to an appropriate level?			
1.6	Is there a clear understanding of the true cost (direct plus indirect) of supply chain risk events?			
1.7	Is the estimate of the cost made and reviewed at frequent intervals?			
1.8	Are there any pre-defined management			

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SI. No.	PARTICULARS	Yes	No	NA
	responses corresponding to increased levels of supplier risk?			
1.9	Has the entity focussed on early intervention and identification of any default than a crisis management?			
1.10	Is there a contingency plan for recovery in the event the distributor/ distribution system fails for any reason?			
<i>Distribution Network Configuration</i>				
2.1	Has the entity analysed the benefit of an external distributor as against an internal system?			
2.2	Considering the importance of the distribution network, does the entity have a prescribed network and organised system of movement of products?			
2.3	Does the company have a written policy for its distribution network and mobilisation of goods?			
2.4	Does the entity have all its major suppliers at strategic locations?			
2.5	Are the distribution centres located at strategic locations to enable quick movement and timely availability of products?			
2.6	Are there sufficient controls in the entity to ensure that the decisions are made by the appropriate personnel and every movement is authorised by the appropriate level of authority?			
2.7	Does the entity have a process of identifying frequent delays/ errors/ losses and rectifying the same?			

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SI. No.	PARTICULARS	Yes	No	NA
2.8	Does the entity have a control matrix for sourcing of good and products from various production locations, warehouses and distribution centres?			
2.9	Are the controls sufficient to ensure that sourcing is made from the right suppliers/ distributors and available on a timely basis?			
<i>Distribution Strategy</i>				
3.1	Does the entity have a strategy for efficient handling and managing inventory movement?			
3.2	Does the strategy clearly cover all areas of decision making?			
3.3	Is the strategy renewed at a frequent basis?			
<i>Trade-Offs in Logistical Activities</i>				
4.1	Has the entity made an evaluation of the cost of alternatives possible?			
4.2	Does the entity have a scientific basis of evaluation of the overall cost of transportation?			
4.3	Has the method of evaluation of cost of transport between options made in a comprehensive manner?			
4.4	Do the Logistics company cause any critical operational problems? Are they reliable?			
4.5	Has a comprehensive agreement made with them to ensure that the Logistic Company would bear the risks related to transportation of goods?			
4.6	If the entity has an in-house logistics division, are there sufficient controls within the Company to ensure that there is no excess cost involved in transportation?			
4.7	Are there written policies for logistics cost to be incurred?			

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Sl. No.	PARTICULARS	Yes	No	NA
Information				
5.1	Does the entity have a comprehensive system to track all the costs incurred for logistics operations and distribution system management?			
5.2	Does the entity make a risk analysis based on such information?			
5.3	Does the entity has a comprehensive system to study the transportation time, transportation cost per location?			
Inventory Management				
6.1	Does the entity have sufficient control on the individual product stock available at different locations?			
6.2	Is there an automated/ semi-automated system of routing of inventory from different locations to enable the smooth disposal of products?			

Payroll

8.26 In a waste management industry, the cost of payroll in relation to the turnover of the entity might not be very significant. But the success of the waste management company depends on the management of personnel and the availability of personnel. Though the entity individually might be hiring huge number of employees, but the collective employment given due to the waste management industry is quite significant in terms of number of people employed in this sector across the nation.

Most entities process payroll for the month, based on the records of a different period. Say payroll for the month of December is processed, the leave records, performance record for the period 25th November to 24th December would be considered. The main reason for such processing is to ensure disbursement of payroll by the specified day of the month. The internal auditor needs to ensure that proper, adequate, and appropriate cut-off procedures are in place to ensure proper computation and disbursement

of salary to the employees. However, with the advent of biometric and automated attendance systems, such time lags are no longer an issue and therefore, companies are able to move towards on-line tracking of time records.

8.27 The procedures for computations of amounts to be deducted on various heads also need to be verified in accordance with organisational policies and procedures. The internal auditor needs to verify the policies and procedures and compliance of the same on a sample basis.

Compliance with various regulations too is a tedious job especially when the entity has presence across different states. In such a scenario, the entity may have to obtain separate registration certifications under different statutes such as, GST, Shops and Establishments Act, Professional Tax, Tax Deduction Account Number (TAN), to name a few. It should also display respective registration certificates in every office. The entity has to create a few protocols and standard operating procedures(SOP) for ensuring compliance with regulations. The entity should ensure to follow these protocols and SOP to comply with various compliances. To make sure the compliances are going on smooth across various places of businesses, entity may prepare a compliance dashboard to track compliance at all the offices across the country.

A *time sheet* is a method for recording the amount of a worker's time spent at work to enable tracking of details related to leave and absence to enable the determination of employee's compensation accordingly. In some situations, the recording of time sheet is done through an electronic/ automatic process and is driven by software. In such cases, the internal auditor is required to understand the process in detail and verify the process on a sample basis. Exceptions if any noted on the project should be taken seriously by the internal auditor and adequate explanations should be obtained.

8.28 The internal auditor may also perform additional analytical procedures over a period of time and compare them for ascertaining any inconsistency such as following:

- (i) No. of bills raised/ no. of hours

This ratio is determined by the number of bills an employee process to the total time taken by him over a period of time. By analysing this ratio, the internal auditor can understand the skill level of employees, steps taken by the management towards maintaining efficiency, importance of training and ability of the management in identifying the right person for the job.

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This ratio gains significance especially because, by processing of bills quickly, customer's satisfaction can be maintained and thereby enables development of brand and loyalty.

(ii) Total Revenue per location to number of employees/ employee cost.

This ratio can be computed based on the total revenue of the location during a particular period to the number of employees/ employee cost in the same month. This would provide an insight for the internal auditor to understand the importance of a firm in terms of its significance.

(iii) Employee Turnover Ratio

Employee turnover ratio helps the internal auditor to verify the attrition rate and assess the entity's effectiveness and steps taken towards prevention of attrition and retention of key employees. In case of employee turnover ratio being higher than the industry, the internal auditor must obtain explanations for the reason for such high turnover ratio.

(iv) Reconciliation with respect to changes in the no. of employees due to additions, terminations, retirements, etc. between various months.

The internal auditor can assess the movement in employees for a month in comparison with another through tracing the additions and deletions in month based on each grade and obtain an insight on the plans of the management.

8.29 Model Checklist related to Payroll Process is as follows:

S. No.	PARTICULARS	Yes	No	N/A
Specific Areas of Payroll Processing				
1.1	Does the entity have a payroll process as approved by appropriate level of authority?			
1.2	Is the payroll process complete in all aspects, as applicable to the entity? Does the entity maintain a checklist of statutory remittances to be made on account of PF, ESI, Labour Welfare Fund and alike?			
1.3	Are cheques prepared and signed by two different employees?			
1.4	If the entity opts for bank transfer, is there			

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S. No.	PARTICULARS	Yes	No	N/A
	sufficient Level of Authority to issue to a bank transfer instruction to the bank?			
1.5	Is the payroll processing cross checked before payment is made?			
1.6	Are there sufficient manual records maintained by the entity with regard to their recruitment, offer letter, appraisals and increments and all other correspondences with the employee?			
1.7	Have the incentive schemes been verified by the internal auditor on a test basis?			
1.8	Are controls in place to ensure that incentives are computed in accordance with the schemes?			
1.9	Have these controls been tested for effectiveness?			
1.10	Have we performed sample testing of incentive workings made and paid to the employee to ensure adherence to the Incentive system?			
1.11	Is the attrition rate exceedingly high? Have justifications for such a high rate, if any obtained?			
1.12	Does the entity maintain separately all complaints, redressals received from the employees ?			
1.13	Have the reasons and explanations for any failures and control weakness observed on review of these complaints?			
1.14	Does the entity have sufficient controls, records for cases where disbursements are made to employees working from various locations?			

Other points to be considered while auditing Human Resource Management and payroll processing are given below:

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Sl.No.	Particulars
<i>Compare actual HR expenditure vs budgeted and document the reasons for deviations. Verify whether any approvals are obtained for such excess spending</i>	
1.1	Check manpower planning for the year.
1.2	Verify whether pay heads as considered in appointment letter are in line with company's compensation policy.
1.3	Check whether minimum wages are being offered in line with applicable State Laws.
1.4	Check whether resigned employees continue to appear in master data.
1.5	Compare resigned and fresher's list as provided by HR with Pay register and employee master data and note down discrepancies.
1.6	Compare salary payable as per pay register and paid as per NEFT sheet / cheque / cash.
1.7	Check how salary disbursed in cash is documented.
1.8	Verify the process of issue of ID cards to employees and related documentation.
1.9	Verify overtime payment, compensatory offs.
1.10	Verify incentive in line with approved policy.
1.11	Check various deductions required under respective statues are being complied and remittance of the same is done within due date.
1.12	Policy verification for onsite workers who have access to cash.
1.13	Ensure return of company's property given to employees.
1.14	Check feedback procedure of employees.
1.15	Verify how many leaves can be carried forward to next year, how many leaves will lapse and how many leaves can be encashed.
1.16	Verify the process of attendance management adopted by management.
1.17	Check for instances wherein employee is absent as per bio metric report but the same is considered as present as per pay register or

Sl.No.	Particulars
	master attendance register. Check for control procedures in such instances.
1.18	Mobile policy and its implementation and documentation.

Fixed Assets

8.30 In general, an entity operating in the waste management industry would have the following types of fixed assets:

- Freehold land and leasehold land
- Buildings, warehouses, and leasehold improvements
- Plant and machinery
- Office equipment
- Computer and software
- Furniture and fixtures
- Electrical installations
- Vehicles

In the event of a comprehensive distribution system operated by the entity, the entity might have a large number of warehouses and storage locations apart from transportation vehicles. The entity may be required to have sufficient control in such cases to ensure that the assets are put into proper usage and periodic physical verification might be of paramount importance.

8.31 There could be instances wherein the entity might lease certain assets for installation at the location. The internal auditor may be required to verify whether there is proper control over such leased assets.

The internal auditor might be required to ensure that there are sufficient controls within the entity to differentiate between own assets and those assets provided by the vendors/ manufacturers to promote their product.

8.32 The internal auditor may also perform additional analytical procedures over a period of time and compared them for ascertaining any inconsistency such as following:

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(i) Ratio of assets installed to area

The internal auditor might verify the ratio of the total value / no. of assets put to use per square foot across different stores and in case of any significant difference arising in such a ratio, the internal auditor needs to seek explanation thereon.

(ii) Asset utilisation ratio

Asset utilisation ratio is the ratio of total revenue to the total assets. It helps the internal auditor to assess the effectiveness of assets with respect to the revenue made by the entity. The greater the asset utilisation ratio, the entity is operating at a higher efficiency.

(iii) Asset coverage ratio

Asset coverage ratio is a measure of a specific company's ability to cover the amount of its existing debts. Essentially, an asset coverage ratio measures the tangible physical and monetary assets of a company against its outstanding debts and overall liability to derive an understanding of the company's current financial position. This measure is usually part of a larger liquidity analysis, which takes into consideration factors like, cash in hand, long-term financial obligations, and current liquidity assessments.

If the internal auditor is required to perform fixed asset verification procedures too as part of the scope of his work, the auditor can refer to *Guidance Note on Audit of Fixed Assets*.

8.33 Model Checklist related to Fixed Assets is as follows:

S. No.	Particulars	Yes	No	N/A
Audit of Fixed Assets				
1.1	If there are assets issued to employees, does the entity have sufficient control over such assets? Are these assets verified on a frequent basis?			
1.2	Does the entity have sufficient protection for its assets from both internal and external damage?			
1.3	Does sufficient control and process exist to ensure capitalisation of assets on the appropriate date?			

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S. No.	Particulars	Yes	No	N/A
1.4	Has the entity taken assets on lease and is there sufficient control on such assets?			
1.5	In the case of assets held at mobile/ temporary location, does the entity have sufficient control over them and do they make a periodic physical verification?			
1.6	How are assets received from manufacturers identified and ensured that they are not disposed off?			
1.7	In the event, the entity is dealing with distribution are their sufficient controls and procedures to ensure appropriate classification of assets owned by the entity and assets owned by the distribution partner?			

Other points to be considered while auditing fixed assets and capital work in progress are given below:

S. No.	Particulars
<i>Budget for capital expenditure as approved by Board for the FY. Compare with actual capital expenditure and arrive at variances</i>	
1.1	Whether CAPEX form is maintained which contains budgeted amount, utilised amount and unutilised amount.
1.2	Map current years additions in fixed assets as per Books with Fixed Assets Register.
1.3	Check useful lives of fixed assets as per Schedule II of Companies Act, 2013 vis-a-vis FAR and arrive at deviations, if any.
1.4	Check the process of obtaining confirmation from employees regarding assets which are with the custody of employees.
1.5	Check are there any assets with the custody of vendor or third party. If yes, check how the same is tracked & monitored. Check the process of obtaining confirmation from vendor for existence of assets with his custody.
1.6	Whether competitive quotations are obtained before raising

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S. No.	Particulars
	Purchase Order (Min 3 quotations recommended).
1.7	Whether invoice / Proforma invoice, PO & GRN are cross verified before passing entries in books (Three-way mapping).
1.8	Check whether asset tagging is done & verify the tracker for the same.
1.9	Whether Fixed Assets Register contains details as enumerated in CARO, 2020.
1.10	Check the method of depreciation followed. Check whether depreciation calculated as per Fixed Assets Register is correct and there are no material differences.
1.11	Whether any process is in place to check if any indication of impairment of assets as on reporting date is existing.
1.12	Obtain insurance copies and check adequacy of risk covered with the insurance.

Security

Physical Security

8.34 The most important driver for the physical security is the need of entity to safeguard their property, staff, customers and the waste collected for treatment/ disposal. Entities also use physical security as a deterrent to prevent miscreants entering the premises and cause damage to the environment by adding chemicals which is dangerous to the health and environment. Entities also view loss prevention as an essential management tool. Further, to ensure enhanced security, entities are looking towards technology and automated systems to prevent crime. The tools include video surveillance and integrated systems.

Ensuring the security of organization would mean protecting customers, staff and assets, preventing miscreants from creating problems while benefitting from complete visibility of sales floor, point-of-sale (POS), receiving doors, distribution centres and parking facilities. It would involve security for the following areas/ activities.

- (i) In-Store
 - Ensure integrated surveillance of POS and cash-handling areas

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- Manage access to restricted areas and locked displays.
 - Protect customers and employees.
 - Verify fire, intrusion and electronic article surveillance (EAS) event alarms using video.
- (ii) Back Office and Warehouse
- Protect employees and prevent theft.
 - Safeguard assets and equipment
 - Monitor productivity and safety.
 - Track time and attendance through access control
- (iii) Parking and Outdoor Premises
- Identify suspicious vehicles.
 - Ensure entry and exit point security.
 - Protect assets and buildings.
 - Monitor merchandise delivery.

Further, International organizations have also established standards and guidelines for physical security as part of an overall security management program that also includes information security and meets governmental requirements and consumer expectations.

8.35 Certain examples of internationally recognized standards and guidelines that are used to implement management systems to effectively manage physical security pertaining to the Waste management industry would include:

- BS 25999-1:2006: Business Continuity Management Code of Practice (management system for disaster recovery and business continuity)
- ISO/PAS 28000: Specification for Security Management Systems for the Supply Chain (management system specification for physical security)
- OHSAS 18001: Occupational Health and Safety Management (specification for health and safety management systems)

The internal auditor might extend his scope of internal audit to verify the importance given by management to Physical security. Further, he might be

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able to understand and correlate the relationship between reduction of costs related to theft/ shrinkage in relation to the costs incurred for enhanced physical security.

8.36 An illustrative list of procedures that an internal auditor might perform in the area of Security would include following:

S. No.	Particulars	Yes	No	N/A
Physical Security				
1.1	Does the entity provides sufficient importance to physical security and security measures?			
1.2	Are the security arrangements made reviewed by the management on a periodic basis to ensure that there is sufficiency of security measures at each location?			
1.3	Does the management ensure a continuous shifting of security personnel from each location?			
1.4	How does the management treat intrusion of miscreants in the event the miscreant has been traced?			
1.5	Does the management believe in periodic modification of security procedures and systems to ensure that there is limited possibility for external people and employees in ascertaining failures in internal security?			
1.6	Does the management make an estimate to verify as to what would be the maximum possible loss in the event of failure of security measures and systems?			
1.7	Are there sufficient Disaster recovery systems within the organisation to act in the event of any mishap/ failing of security measures? Are the employees sufficiently trained in that aspect?			

Operating Costs

8.37 The significant operating costs in any waste management entity include the following:

(i) Lease Expenses

Lease expenses could be of the nature of leasing of office building for workspace or leasing of assets for official purpose or accommodation provided to employees. This would be a significant part of the expenses considering that the entity needs to own the location or lease the location for its display. The success of the entity is based on location of entity and incidentally to have an entity at the right location would mean incurring higher cost.

(ii) Advertisement and Marketing Expenses

Advertisement expenses are incurred predominantly for the purpose of creation and development of a strong brand name apart from creating awareness among the generator of waste. Branding is one of the most important aspects of any business, large or small, retail or Business to Business (B2B). An effective brand strategy gives a major edge in increasingly competitive markets. A brand is something that tells the customers (existing and prospective) what they can expect from the entity's method of working.

There are many strategies that the entity might use for marketing below:

Multi-channel marketing is marketing using many different marketing channels to reach a customer. In this sense, a channel might be the employee collecting waste, NGOs associated with the waste management industry, restaurants, hospitals, public utility places a web site, a mail order catalogue, or direct personal communications by letter, e-mail or text message. The objective of the company doing the marketing is to make it easy for a consumer to connect with the entity whenever they require in whatever way it is most appropriate.

To be effective multi-channel marketing needs to be supported by good supply chain management systems, so that the details are displayed consistent across the different channels. It might also be supported by detailed analysis of the return on investment from each different channel, measured in terms of customer response and conversion of sales. Multichannel marketing allows the waste management entity to reach its prospective or current customer in a channel of his/ her liking.

(iii) Finance Charges

Finance charges are incurred for the purpose of working capital and capital expenditure of an entity in waste management industry. The entity needs to

ensure cost efficiency in borrowing of funds. The entity might also opt for an External Commercial Borrowing for the purpose of incurring expenditure in foreign currency.

Maintenance of Books, Reporting, Management, Control & MIS

8.38 The internal auditor is required to verify the sufficiency of controls related to maintenance of books of accounts by the entity. The internal auditor is also required to verify the controls for allocation of costs between different departments in every location and whether it is adequate and reliable in the light of overall business operations.

An entity might have various stores and accounting operations might be performed centralised, decentralised or may be a combination of both. The entity might find it best suited if the accounting system is comprehensive enough to provide a Management Information System which would be sufficient to provide information for decision making and enable the entity to understand complexities of business, status of implementation of new ideas and last the true status of operations of the entity.

8.39 The Reporting system should be comprehensive enough and should be able to provide the following information:

- (i) Sales and Collection:
 - Daily statement of sales through Cash and credit sales.
 - Reconciliation between Bills raised and collection status with outstanding debtors.
 - Benefits of advertisement through additional revenues and customer loyalty.
- (ii) Inventory Management:
 - Loss of inventory on account of theft, spillage / perishing of goods.
 - Inventory at each location based on type of waste, stage of disposal of waste.

8.40 Model checklist related to maintenance of accounts and documents is as follows:

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S. No.	Particulars	Yes	No	NA
<i>Books of Accounts and Documents</i>				
1.1	Does the Entity have proper accounting system commensurate with the regulatory requirements?			
1.2	Does the Entity have specific books of accounts for each location across states to enable proper declaration of turnover in terms of quantity and value for statutory purposes?			
1.3	Are the Control Systems in place in estimating the revenue generated location-wise sufficient to ensure that proper books are maintained for the location?			
1.4	Does the Entity have location wise employee details to ensure proper allocation of payroll cost to the location?			
1.5	Are the books of accounts closed every month?			
1.6	Are the books of accounts closing every month? Whether the time period for the closure of the books of accounts on a monthly basis is reasonable with regards to the operations of the entity			
1.7	Are the controls for re-opening of books proper to ensure prevention of manipulation?			
1.8	Are the books maintained in a manner to provide Information to the management for decision making?			

Surprise Verification

8.41 If physical verification or examination is done without prior information to the management, it is called as surprise check. An element of surprise is experienced by management or the employee in such cases. Surprise check is used in physical verification of cash, security items, inventory etc. Further, the internal auditor might also consider surprise check towards compliance of required procedures and policies by the employees of the organisation.

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The Internal Auditor might use surprise checks as an effective tool for finding effectiveness and continuity of internal controls.

Procurement

8.42 Procurement involves every activity involved in obtaining the goods and services a company needs to support its daily operations, including sourcing, negotiating terms, purchasing items, receiving and inspecting goods as necessary and keeping records of all the steps in the process.

Model Checklist for verification of procurement process is as follows:

S. No.	Particulars
<i>Evaluation of procurement planning</i>	
1.1	Verify whether the PI/PR are raised as per the process
1.2	Checking for any back dated PO and analyse the same
1.3	Duplication of purchase order in ERP
1.4	Verifying the missing Purchase orders
1.5	Check the instances for same PO number for different vendors
1.6	Verification of Split POs
1.7	Obtain the Approved Vendors List & check for purchases from any unapproved vendors
1.8	Check if the same Stock Keeping Unit (SKU) Code with different SKU Description in the GRN and Product Sale Report
1.9	If the GRN Delivery Date is after the PO Expiry Date
1.10	Check if there are any different tax rates of same SKU in the same location as per the GRN Report
1.11	Verify the process relating to supply chain (distribution process) of inventory and its related cost

Major Expenditure Review

8.43 An expense is the cost of operations that a company incurs to generate revenue. Major hike in expenses can lead to huge losses. Therefore, proper audit of expenses has to be conducted.

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Model Checklist for review of major expenditure is as follows:

S. No.	Particulars
<i>Conduct an analysis of increase/ decrease in direct expenses vis a vis the turnover/ consumption</i>	
1.1	Obtain and analyse reports of direct expenses incurred vis a vis the key vendors and their prices.
1.2	Obtain the rental master, if any.
1.3	Identify the expired agreements and document the same.
1.4	Obtain the breakup for the opening balance of prepaid expenses.
1.5	Claims made are compared against premiums paid to help determine whether insurance cover may need to be extended or reduced.
1.6	Evidence of supplier and contractor compliance with contractual insurance obligations is updated annually.
1.7	Coverage of assets at third party locations is considered, i.e. in-transit materials, leased warehouses, consignment inventories.
1.8	Responsibility for insurance of third party goods or equipment held on company sites is clearly defined and documented.
1.9	Insurance coverage is obtained for all areas where it is required by law, regulation or contract (e.g. motor vehicle insurance, employer liability insurance).
1.10	Where assets and exposures are self-insured, management responsibilities are clearly established and adequate safeguards exist over the assets.
1.11	If all the personnel are notified of the procedures to be followed in the case of accidents, loss or damage to property so that necessary information can be obtained on a timely basis for any subsequent claim.
1.12	Insurance claims are promptly prepared and submitted, recorded and follow-up with the insurance company.

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S. No.	Particulars
1.13	A claims register is maintained and regularly reviewed to ensure prompt progressing of claims.

Loans

8.44 Model Checklist for verification of loans is as follows:

S. No.	Particulars
<i>Obtain list of loans during the period</i>	
1.1	Verify the loan agreement and check compliance of all the terms and conditions
1.2	Verify all the documents relating to new loans obtained and existing loans closed
1.3	Verification of loan statements
1.4	Summary of loan agreements
1.5	Interest calculations
1.6	Verification of Books Vs Loan statements
1.7	Verify repayment schedule of loans taken

Chapter 9

Specific Issues Related to Internal Audit

Revenue Earned by the Company

9.1 The revenue model of the waste management company will be different from that of other companies. The company might earn revenue from waste collections from residential areas which includes organic and inorganic wastes, industrial waste which includes metal and other scraps and other commercial wastes like, bio-degradable and non-bio-degradable wastes and wastes which cannot be recycled or reused.

The following is the check list for auditing the revenue model of a waste management company. This is not an exhaustive checklist.

S. No	Particulars
<i>Internal Audit of Revenue</i>	
1.1	Does the company have any contracts with buildings in residential areas?
1.2	Does the company process organic waste into compost? If it is processing then what is the method used to arrive at the selling price?
1.3	Does the company sell the compost for both agricultural and domestic use? If yes, then is it selling at different prices?
1.4	Does the company process the inorganic waste and sells it directly to customers or does it sells the inorganic waste to a third party?
1.5	If the company is selling the inorganic waste by processing then what is the method used to determine the selling price?
1.6	If the company is selling it to a third party then what is the method used to determine the selling price? Whether it calls for a tender or has a contract with few of the parties?

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S. No	Particulars
1.7	Does the company enter into contracts with its clients for collecting and segregation of waste?
1.8	Are the charges collected by the clients towards collection and segregation of waste or only towards collection?
1.9	If the company has to segregate the waste does it collect separate charges towards segregation?
1.10	Is the contract with the clients renewed periodically or is termination being initiated by the clients?
1.11	Does the company dump the inert wastes (which cannot be recycled or reused) into landfills?
1.12	If it is dumping it into landfills has it taken the prior approval of local municipal bodies and the government?
1.13	Has the company entered into an agreement with the local bodies and the government to fix a tipping fee for dumping of waste into the landfills?
1.14	What is the frequency at which the company will be paid the tipping fee, i.e., whether monthly, quarterly, etc.?
1.15	Is the company being paid only the tipping fee or is it also receiving reimbursements for transportation and other expenses?
1.16	Does the company processes waste metal and converts it into scrap used for industrial process?
1.17	If the company is selling the scrap what is the method used to determine the selling price? Whether it calls for a tender or has a fixed price in tune with the industry standards?
1.18	Does the company shreds paper, cardboard, textile or recycles and sells it?
1.19	If the company is recycling the paper and cardboard is it selling it as finished goods to the end users or is it selling it as raw material for further processing?
1.20	Does the company undertake document destruction? If yes, what are prices charged for wholesale and retail customers?
1.21	Does the company recycle such shredded documents or incinerate them?

Specific Issues Related to Internal Audit

S. No	Particulars
1.22	Does the company buys used furniture, cardboard boxes that could be recycled and reused? If yes, what is the method used by the company to determine the selling price of the products?
1.23	Does the company receive any subsidies or grants from state or central government?
1.24	Does the company receive any concession for setting up of the plant or for its operation or renewal or obtaining of licenses?
1.25	What is the weighing measure used for calculating the weight (e.g., kilograms, tons etc.)? What is the price per kg/ton of waste sold?

Other points to be considered while auditing revenue recognition & billing process are as given below:

S. No.	Particulars
<i>Understanding the functioning of the revenue software with adequate documentation</i>	
1.1	Obtaining of agreements with customers/ MOU, if any and verifying their adherence.
1.2	Verification of Customer Purchase Orders.
1.3	Verification of Sales Orders generated by the company, if any
1.4	Comparison of Customer purchase orders received and internal sales order generated.
1.5	Verifying the accuracy in calculating the statutory taxes along with the invoices.
1.6	Verification of delay in accounting (Time gap between Transaction date and Accounting date).
1.7	Analyse double booking of invoices or duplication of invoice numbers.
1.8	Deferred revenue analysis.
1.9	Unbilled revenue analysis.
1.10	Verify the collection controls (Cash/ Bank) and deposit of cash to bank accounts on periodic basis.
1.11	Understand the sales return process and verify/ check the approvals and controls for the same.

Verification of Major Expenses

9.2 The major heads of expense that may be incurred in waste management company would be:

- Labour charges
- Processing charges
- Transportation of wastes
- Disposal expenses.

Labour Charges

9.3 Labour charges refer to the various employee expenses incurred in order to ensure that the operations of waste management company like, collection and segregation of waste, processing and incineration of waste, transportation and disposal of waste, etc., are carried out smoothly. Following are the steps involved in audit of labour charges:

S. No.	Particulars
Labour Charges	
2.1	Check whether any muster roll or payroll to record the payroll expenses employee wise.
2.2	Verify if the labour is hired by the company itself or they have been hired on contract basis from a third party.
2.3	Verify the contracts with the clients to ascertain whether the personnel for carrying out the collection, segregation and disposal had been hired by the company or by the client.
2.4	Verify monthly booking of labour charges and check if it is tallying with the muster roll.
2.5	Verify if there is any register or log maintained for the quantity waste collected and segregated or disposed of by each employee.
2.6	Obtain an understanding of the employee benefits and post-employment benefits like, pension, provident fund, etc. offered to employees and labour by institutions.
2.7	Verify the procedure of valuation and disclosure of employee benefits with reference to Accounting Standard 15 "Employee Benefits".

Specific Issues Related to Internal Audit

S. No.	Particulars
2.8	Review the personnel file maintained for work records for checking hours worked, time reports, payments made, etc.
2.9	Check the contracts of employees hired on part time basis and ensure that they are paid for the period they are employed as per the terms of contract.

Processing Charges

9.4 Processing of waste encompasses following major steps:

- (a) Treatment of effluents
- (b) Processing of scraps for resale
- (c) Segregation of solid wastes into organic and inorganic wastes.
- (d) Incineration of wastes

The steps involved in audit of processing charges are as follows:

S. No	Particulars
Processing Charges	
3.1	Check various input of wastes and check the ratio of derivable output for each unit of input waste.
3.2	Verify if the waste which is processed can be further processed or should be disposed of as per the rules of Pollution Control Board.
3.3	Verify if the processing is done as per the rules framed by the Pollution Control Board.
3.4	Review the amount booked under this head under the various ledgers with supporting documents and vouchers.
3.5	Examine whether the processing expenses have been properly classified and disclosed under appropriate account heads in the financial statements in accordance with the recognized accounting principles.

Transportation Charges

9.5 Transportation charges include all expenses incurred towards transporting the waste from the point of collection to the point of treatment

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and later to the point of disposal. The process involved in audit of transportation charges is:

S. No	Particulars
Transportation Charges	
4.1	Verify whether the company owns the trucks and tippers, or it has taken them on hire.
4.2	Review the contract agreements if the vehicles are taken on hire.
4.3	Verify whether the vehicles will be hired by the company or by the client.
4.4	Check whether there are security stamps, check in pass, etc. for the waste being transported inside and out of the factory.
4.5	Check the entries recorded in books with supporting documents and vouchers for expenses relating to transporting charges.
4.6	Verify that exact quantity of waste sent from one location reaches the other location in same quantity.
4.7	If there is a difference in quantity the reason for the same has to be enquired and verify if it is a normal or abnormal loss.
4.8	Examine whether the transportation expenses have been properly classified and disclosed under appropriate account heads in the financial statements in accordance with the recognized accounting principles.

Disposal Expenses

9.6 Disposal expenses relates to all the expenses incurred for the final disposal of the wastes. Different kinds of wastes have to be segregated and disposed in right ways. Wrong disposing techniques leads to fatal health issues.

The process of auditing the disposal expenses is as follows:

S. No	Particulars
Disposal Expenses	
5.1	Verify the agreements with third party for disposal of final wastes.
5.2	Verify if the wastes have been disposed in proper methods and ways as per the rules framed by the Pollution Control Board.

Specific Issues Related to Internal Audit

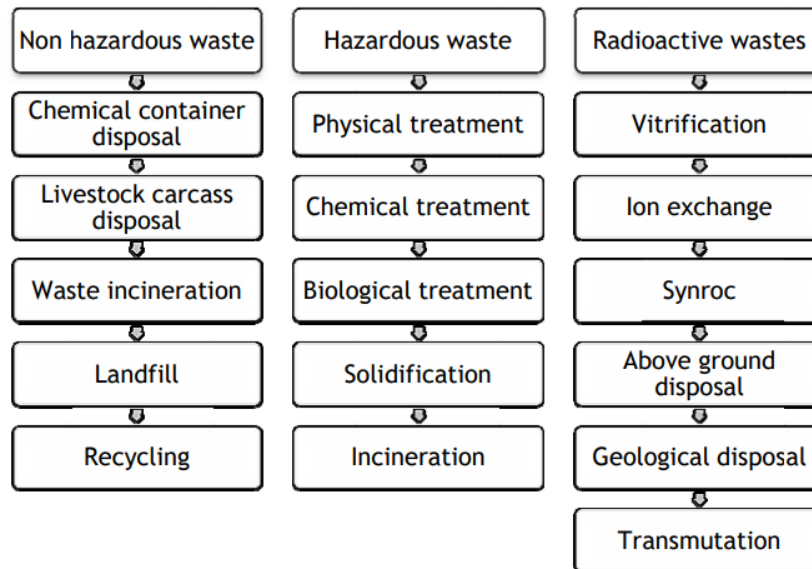
S. No	Particulars
5.3	Check the amount booked under various ledgers with supporting and vouchers relating to disposal expenses.
5.4	Verify if there is any spillage of wastes during the disposal process and if there is any spillage; verify the steps taken to clean it.
5.5	Examine whether the disposal expenses have been properly classified and disclosed under appropriate account heads in the financial statements in accordance with the recognized accounting principles.

Types of Wastes and Disposal Techniques

9.7 Industries are of different kinds using different inputs. Hence, the output wastes generated by each of the industries would differ. The different kinds of wastes generated would be mainly classified as under:

- Non-Hazardous wastes
- Hazardous wastes
- Radioactive wastes

The following are ways of disposal of different types of wastes:



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9.8 The process of audit of disposals is as following:

S. No	Particulars
1.1	Check the total waste obtained by the company and how much waste of is apportioned to be disposed.
1.2	Verify whether such wastes have to be disposed of by burying it in landfills or by incineration.
1.3	If it has to be filled in landfills, verify the documents granting permission by the government to fill it in that particular landfill or verify if it is notified by the government as a landfill.
1.4	Verify the documents given by the government to ensure that there was a landfill in the first place.
1.5	If the company claims that it has filled up a landfill, then physically verify that the landfill is filled completed and it is the same landfill the permission for which is granted by the government.
1.6	Do reverse calculation: Total Waste collected – Scrap – Recycled – incineration – treated waste = Waste for disposal.
1.7	Ensure that there are no transportation spills and if there are any, then verify if any steps are taken to clean the same.
1.8	There should be proper check in and checkout of waste.
1.9	The disposals should have a proper time roll where it shows the quantity and time at which waste for disposals move out.

Additional Issues

9.9 Apart from the usual procedures undertaken by the internal auditor, there are certain specific areas that require his attention in case of entities generating and disposing of the waste on its own. They are:

- (a) Whether the waste generated has been collected and stored before disposal based on its type.
- (b) Whether the entity has adequate infrastructure for processing the waste.
- (c) Whether such infrastructure complies with specifications as prescribed in various laws regarding waste management.

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- (d) Whether the entity is providing adequate training to its employees engaged in the waste management process.
- (e) Whether the entity is providing regular health check-ups for its employees and is maintaining a record for the same.
- (f) Whether the entity is providing adequate accessories like, gloves, etc to the employees.
- (g) Whether the entity has got vehicles for transporting the waste generated in the factory to the premises where it is disposed.
- (h) Whether the equipment used for processing the waste has been maintained regularly.
- (i) Whether the entity has water treatment plant? If so, how the sludge created is disposed of.
- (j) How are the waste generated treated by the entity for costing/ accounting purposes.
- (k) Whether the entity is filing annual report regarding waste management within the due date specified in the respective Acts.
- (l) Whether any notice has been served on the entity with regard to waste generation and disposal by pollution control board? If yes, what is the action that has been taken by the entity.
- (m) Whether the persons engaged in the treatment of waste are outsourced employees or they are in the pay register of the company.
- (n) Whether the entity has complied with labour laws relating to such employees.
- (o) Whether the entity is conducting awareness program regarding waste generated and disposed to its employees on regular basis.

9.10 In case of entities engaged in the collection and disposal of waste, apart from the general areas of internal audit and the specific areas mentioned above in relation to disposal of waste, the following additional areas require auditor's attention. They are:

- (a) Whether the entity is engaged in collecting waste for disposal from business units? If yes, whether the entity has entered into any agreement with such business units.

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- (b) Whether the term of agreement specifies the periodicity of collection, consideration for collecting the waste, containers for different type of waste, etc.
- (c) Do the term of agreement specify whether the persons engaged in the waste collection have to be employed by the entity or the business unit.
- (d) Whether any person has to be placed at the location of the business unit for segregating the waste on generation.
- (e) Whether the entity has signed employment contracts and such contracts provide for benefits available to employees due to health hazards arising out of handling waste.
- (f) Whether the entity has obtained license for collecting and treating the waste from the local and statutory authorities.
- (g) If the said license is on renewable basis, whether the entity has renewed the license periodically.

Chapter 10

International Agreements on Waste

10.1 Environmental care is of global interest and vital importance. The term pollution has nothing to do with national boundaries and have spread freely across the countries and continents. The international community has recognized this fact, a number of attempts to improve the environment have been recorded on paper during the last few decades. The most relevant of these agreements regarding waste are discussed below.

Agreements Including Non-Hazardous/ Solid Waste

10.2 Legislations concerning waste are usually differentiated according to the type of waste. International conventions often cover nuclear and hazardous waste, whereas non-hazardous waste, often called solid waste, is more usually regulated at the national level. However, there are a few international conventions that also cover non-hazardous waste. OECD and the EU have adopted policies recommending its member countries to establish a framework for a national waste management system. For example, The OECD Recommendation C (2004)¹⁰⁰, recommends member countries to implement policies and programs to ensure that the waste is managed in an environmentally friendly and economically efficient manner. Examples of recommendations are as follows:

- Internalisation of human health and environmental costs in waste management.
- Providing incentives to take part in environmentally sound recycling schemes.
- Having a regulatory infrastructure at an appropriate government level.
- Developing instruments and practices for waste management.
- Ensure the facilities operate according to best available practices/ techniques.

OECD Recommendation on Resource Productivity (2008) promotes international policies to prevent and reduce waste generation and achieve sustainable material management.

Agreements Including Hazardous Waste

10.3 In the late 1980s, a tightening of environmental regulations in industrialised countries led to a dramatic rise in the cost of hazardous waste disposal. Searching for cheaper ways to get rid of this type of waste, "toxic traders" began shipping hazardous waste to developing countries. There are few international conventions and agreements that cover hazardous waste.

They are presented below:

(i) Basel Convention

The Basel Convention on Control of Transboundary Movements of Hazardous Wastes and Their Disposal was signed in the year 1992 having 190 Parties to the Convention. This treaty does not include the activities of waste relating to the radioactive waste. The Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their disposal is a global agreement addressing the problems and challenges posed by hazardous waste. The key objectives of the Basel Convention are to minimize the generation of hazardous waste in terms of quantity and hazardousness, to dispose of them as close to the source of generation as possible and to reduce the movement of hazardous waste and to reduce the international movements of hazardous wastes between nations and the transfer of hazardous waste from developed countries to less developed countries. It developed criteria for "environmentally sound management". A control system, based on prior written notification, was also put into place.

On a popular outcry most of the countries in the world agreed to include plastic waste as a regulated material excluding the United States, which is a major producer of plastic. Since United States is not a party to the treaty, the Basel Convention was amended in relation to Plastic waste amendments on the basis of the petition signs received, which as on today binds 186 States (countries).

Environmentally sound management (ESM) is a central goal and means taking all practical steps to minimize the generation of hazardous waste and strictly control its storage, transport, treatment, reuse, recycling, recovery, and final disposal, for the purpose of protecting human health and the environment. One of the guiding principles of the Basel Convention is that, in order to minimize the threat, hazardous waste should be dealt with as close to the place where it is produced, if possible. Therefore, under the Convention, transboundary movements of hazardous waste or other waste

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can take place only upon prior written notification by the state of export to the competent authorities of the states of import and transit (if appropriate). Each shipment of hazardous waste or other waste must be accompanied by a movement document from the point at which a transboundary movement begins to the point of disposal. Hazardous waste shipments made without such documents are illegal.

Following are categories of wastes to be controlled as per Basel Convention

Waste Streams

Y1	Clinical wastes from medical care in hospitals, medical centres and clinics
Y2	Wastes from the production and preparation of pharmaceutical products
Y3	Waste pharmaceuticals, drugs and medicines
Y4	Wastes from the production, formulation and use of biocides and phytopharmaceuticals
Y5	Wastes from the manufacture, formulation and use of wood preserving chemicals
Y6	Wastes from the production, formulation and use of organic solvents
Y7	Wastes from heat treatment and tempering operations containing cyanides
Y8	Waste mineral oils unfit for their originally intended use
Y9	Waste oils/water, hydrocarbons/water mixtures, emulsions
Y10	Waste substances and articles containing or contaminated with polychlorinated biphenyls (PCBs) and/or polychlorinated terphenyls (PCTs) and/or polybrominated biphenyls (PBBs)
Y11	Waste tarry residues arising from refining, distillation and any pyrolytic treatment
Y12	Wastes from production, formulation and use of inks, dyes, pigments, paints, lacquers, varnish
Y13	Wastes from production, formulation and use of resins, latex, plasticizers, glues/adhesives

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Y14	Waste chemical substances arising from research and development or teaching activities which are not identified and/or are new and whose effects on man and/or the environment are not known
Y15	Wastes of an explosive nature not subject to other legislation
Y16	Wastes from production, formulation and use of photographic chemicals and processing materials
Y17	Wastes resulting from surface treatment of metals and plastics
Y18	Residues arising from industrial waste disposal operations Wastes having as constituents

Wastes having as constituents:

Y19	Metal carbonyls
Y20	Beryllium; beryllium compounds
Y21	Hexavalent chromium compounds
Y22	Copper compounds
Y23	Zinc compounds
Y24	Arsenic; arsenic compounds
Y25	Selenium; selenium compounds
Y26	Cadmium; cadmium compounds
Y27	Antimony; antimony compounds
Y28	Tellurium; tellurium compounds
Y29	Mercury; mercury compounds
Y30	Thallium; thallium compounds
Y31	Lead; lead compounds
Y32	Inorganic fluorine compounds excluding calcium fluoride
Y33	Inorganic cyanides
Y34	Acidic solutions or acids in solid form
Y35	Basic solutions or bases in solid form
Y36	Asbestos (dust and fibres)
Y37	Organic phosphorus compounds
Y38	Organic cyanides

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Y39	Phenols; phenol compounds including chlorophenols
Y40	Ethers
Y41	Halogenated organic solvents
Y42	Organic solvents excluding halogenated solvents
Y43	Any congener of polychlorinated dibenzo-furan
Y44	Any congener of polychlorinated dibenzo-p-dioxin
Y45	Organohalogen compounds other than substances referred to in this Annex (e.g., Y39, Y41, Y42, Y43, Y44)

Categories of wastes requiring special consideration:

Y46	Wastes collected from households
Y47	Residues arising from the incineration of household wastes
Y48	Plastic waste, including mixtures of such waste, with the exception of the following:
	• Plastic waste which is hazardous waste
	• Plastic waste listed below, provided it is destined for recycling in an environmentally sound manner and almost free from contamination and other types of wastes
	Plastic waste almost exclusively consisting of one non-halogenated polymer, including but not limited to the following polymers:
	▪ Polyethylene (PE)
	▪ Polypropylene (PP)
	▪ Polystyrene (PS)
	▪ Acrylonitrile butadiene styrene (ABS)
	▪ Polyethylene terephthalate (PET)
	▪ Polycarbonates (PC)
	▪ Polyethers
	Plastic waste almost exclusively consisting of one cured resin or condensation product, including but not limited to the following resins:
	▪ Urea formaldehyde resins
▪ Phenol formaldehyde resins	
▪ Melamine formaldehyde resins	

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	▪ Epoxy resins
	▪ Alkyd resins
	Plastic waste almost exclusively consisting of one of the following fluorinated polymers:
	▪ Per fluoroethylene/propylene (FEP)
	▪ Perfluoro alkoxy alkanes:
	▪ Tetrafluoroethylene/perfluoroalkyl vinyl ether (PFA)
	▪ Tetrafluoroethylene/perfluoro methyl vinyl ether (MFA)
	▪ Polyvinyl fluoride (PVF)
	▪ Polyvinylidene fluoride (PVDF)
	• Mixtures of plastic waste, consisting of polyethylene (PE), polypropylene (PP) and/or polyethylene terephthalate (PET), provided they are destined for separate recycling of each material and in an environmentally sound manner and almost free from contamination and other types of wastes.

List of Hazardous Characteristics:

1	Explosive
2	Flammable liquids
3	Flammable solids
4	Substances or wastes liable to spontaneous combustion
5	Substances or wastes which, in contact with water emit flammable gases
6	Oxidizing
7	Organic peroxides
8	Poisonous (Acute)
9	Infectious substances
10	Corrosives
11	Liberation of toxic gases in contact with air or water
12	Toxic (Delayed or chronic)

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13	Ecotoxic
14	Capable by any means after disposal of yielding another material, e.g., leachate, which possesses any of the characteristics listed above

(ii) Bamako and Waigani Conventions

The Bamako convention prohibits the import of hazardous waste into African region. The Waigani convention prohibits the import of hazardous waste into Pacific Island developing countries.

(iii) Bilateral Agreements between United States and Other Countries

There are separate agreements entered by the United States with different countries for the import or export of hazardous wastes. The agreements between Canada and the United States were entered in 1986 and amended in 1992 for the safe, low cost and sound recycling and disposal of transboundary movement of hazardous waste.

The United States has also entered into agreement with Mexico for the imported recycling and disposal of hazardous waste and exporting only for recycling

The US may import but not export hazardous wastes from the agreements entered with the countries - Costa Rica, Philippines and Malaysia.

(iv) The OECD Decision C (2001)107/FINAL

The OECD was founded in 1961 as an Intergovernmental organisation constituting of 38 member countries. The aim of OECD is to stimulate economic progress and world trade. The Organization for Economic Co-operation and Development (OECD) has instituted binding agreements for its member countries (38 states) regulating the transboundary movements of waste destined for recovery operations. Between 1984 and 1992, eight OECD Council Acts were adopted covering waste identification, definition, and control of transboundary movements of waste. Seven of these Acts are currently being consolidated and updated with the ultimate goal of developing a global control system for waste movements. The control system aims to facilitate the trade of recyclables in an environmentally sound and economically efficient manner by using a simplified procedure and introducing a risk-based approach to assessing the necessary level of control

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of material. Waste exported to countries outside the OECD area, whether for recovery or final disposal, are not subject to this simplified control procedure.

With reference to the OECD Decision on the Control of Transboundary Movements of Hazardous Wastes and their Disposal Destined for Recovery Operations, certain recent amendments have been adopted at the Basel Convention. These amendments have been made towards their list of wastes and further transboundary movement restrictions of electrical and electronic waste. On 16th August 2022, the OCED Decisions relating to the recent amendments were objected in relation to the e-waste. A process is currently under way to look into the matter to create alternative proposal to control the transboundary movement of E-wastes and is targeted to be completed within 1 January 2025, before the Basel amendments become effective.

The OECD control system is based on two types of control procedures:

- Green Control Procedure: for waste that poses a minor threat to human health and the environment and are consequently not subject to any other controls but normally applied in commercial transactions
- Amber Control Procedure: for waste that poses a sufficient risk to justify their control.

(v) London Convention

The London Convention on the Prevention of Marine Pollution by Dumping of Wastes and other matter is a global agreement that was drawn up at the Inter- Governmental Conference on the Dumping of Wastes at Sea in London in 1972. The objective of the Convention is to prevent pollution of the sea by the dumping of waste and other matter that is liable to create hazards to human health, to harm living resources and marine life, to damage amenities or to interfere with other legitimate uses of the sea.

(vi) The MARPOL Convention

The MARPOL Convention for the Prevention of Pollution from ships is the main international convention covering prevention of pollution of the marine environment by ships from operational or accidental causes. It came into force in 1983. Several amendments to the Convention have been made since 2010 such as maintaining records and control of the Ozone depleting substances, mandatory fuel oil change for entering or leaving SECA areas, discharge of any garbage into the ocean with certain exceptions, disposal of acceptable wastes. The key objectives of the Convention are:

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- To eliminate pollution of the sea by oil, chemicals, harmful substances in packaged form, sewage, garbage and other harmful substances that might be discharged in the course of operations.
- To minimize the amount of oil that could be released accidentally by ships, including fixed or floating platforms.
- To improve further the prevention and control of marine pollution from ships, particularly oil tankers.

(vii) Other International Agreements including Hazardous Waste

- (a) Convention on Civil Liability for Damage Caused during Carriage of Dangerous Goods by Road, Rail, and Inland Navigation Vessels (CRTD), Geneva, 1989
- (b) Convention on the Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade, Rotterdam, 1998
- (c) Convention on the Transboundary Effects of Industrial Accidents, Helsinki, 1992
- (d) European Agreement Concerning the International Carriage of Dangerous Goods by Inland Waterways (AND), Geneva, 2000
- (e) European Agreement Concerning the International Carriage of Dangerous Goods by Road (ADR), Geneva, 1957
- (f) FAO International Code of Conduct on the Distribution and Use of Pesticides, Rome, 1985
- (g) Minamata Convention on Mercury, Minamata, 2013
- (h) Stockholm Convention on Persistent Organic Pollutants Stockholm, 2001

Agreements Regulating Radioactive Wastes

10.4 Radioactive wastes are the most dangerous type of waste that would harm the environment as well as human lives. These wastes can be fatal if not handled properly. Some of the agreement related to radioactive wastes are discussed below:

(i) Joint Convention

The Joint Convention on the Safety of Spent Fuel Management and on the 122 Safety of Radioactive Waste Management was the first legal instrument to address these issues directly on a global scale. The objectives of this convention are:

- To achieve and maintain a high level of safety worldwide in spent fuel and radioactive waste management, through the enhancement of national measures and international co-operation, including safety related technical co-operation where appropriate.
- To ensure that during all stages of spent fuel and radioactive waste management there are effective defences against potential hazards so that individuals, society and the environment are protected from the harmful effects of ionising radiation, now and in the future, in such a way that the needs and aspirations of the present generation are met without compromising the ability of future generations to meet their needs and aspirations.
- To prevent accidents with radiological consequences and to mitigate their consequences should they occur during any stage of spent fuel or radioactive waste management

(ii) Convention on Nuclear Safety

The Convention on Nuclear Safety is a global agreement that was adopted in Vienna in 1994. Its aim is to legally commit participating states that operate land-based nuclear power plants to maintain a high level of safety by setting international benchmarks to which states would subscribe. The specific safety obligations in the Convention are based on what are termed "fundamental safety provisions" rather than on highly detailed standards, guidance on the more detailed internationally agreed safety standards is already available, and these are continually being updated.

International Governance Problems

10.5 International Governance Problems are as follows:

Differing Definitions and Lack of Comparable Data

One of the significant obstacle to preventing waste is differing waste definitions and classifications across countries. The Basel Convention allows different countries to have different definitions of waste. Thus, an illegal

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shipment in one country may be legal in another, leading to disputes between exporting and importing countries, resulting in a stalemate. This, may lead to the disposal of containers with hazardous waste in the country of import until an agreement is reached. Although international organizations such as the Basel Secretariat, has taken measures in order to facilitate comparison of cross-country statistics, caution is required in interpreting these. data. The lack of comparable statistics makes it difficult to monitor the characteristics and quantity of waste across countries.

Weak International Cooperation

Different regulatory practices across countries complicate the consistent enforcement of waste shipment legislation. Agencies in different countries may have varying priorities of waste streams, as well as different views on waste classifications. Another obstacle to international cooperation is the lack of information exchange. While one country may have a database with profiles on suspicious waste shipments, another country may have another set of profiles. If an illegal exporter has a profile in one country, he can avoid this by exporting through another country. Further, it is difficult to sanction an exporter whose export declaration is registered in another country than the actual country of export. The general lack of cooperation between national authorities makes it next to impossible to enforce illegal exports through a Country other than the country of dispatch.

Chapter 11

Audit Criteria at the International Level

11.1 Depending on the audit topic and international agreements, domestic legislations and policies will be relevant as audit criteria. As EU members have carried out majority of the reviewed audits, EU directives and regulations often feature as audit criteria in addition to national legislation and national policies. The UK National Audit Office audits serve as a good illustration for the use of both EU and national audit criteria. The 2006 waste audit focused on progress compared to targets imposed by the EU Landfill Directive 1999/31/EC, while the 2009 audit on private finance in the waste sector had both the National Strategy for Waste Disposal and the EU Landfill Directive as criteria. The 2010 audit on business waste adopted the Business Resource Efficiency and Waste Programme 2005-2008, the Waste Strategy 2007, the Landfill Tax 1996 and the EU Landfill Directive as audit criteria to examine how business waste was reduced.

11.2 Other waste-related EU directives and regulations that have been applied as audit criteria are as follows:

- Waste Framework Directive (EU) 2018/851- This Directive lays down measures to protect the environment and human health by preventing or reducing the generation of waste, the adverse impacts of the generation and management of waste and by reducing overall impacts of resource use and improving the efficiency of such use, which are crucial for the transition to a circular economy and for guaranteeing the Union's long-term competitiveness
- Landfill of waste Directive (EU) 2018/850- The aim of this Directive is to ensure a progressive reduction of landfilling of waste, in particular of waste that is suitable for recycling or other recovery, and, by way of stringent operational and technical requirements on the waste and landfills, to provide for measures, procedures and guidance to prevent or reduce as far as possible negative effects on the environment, in particular the pollution of surface water, groundwater, soil and air, and on the global environment, including the greenhouse effect, as well as

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any resulting risk to human health, from landfilling of waste, during the whole life-cycle of the landfill.

- Commission Regulation (EU) No 664/2011- Few types of mixture of wastes have been added to Annex IIIA to Regulation (EC) No 1013/2006 based on the requests received from EU member countries.
- Battery directive 2013/56/EU- This Directive establishes rules regarding the placing on the market of batteries and accumulators and, in particular, a prohibition on the placing on the market of batteries and accumulators containing hazardous substances; and specific rules for the collection, treatment, recycling and disposal of waste batteries and accumulators to supplement relevant Community legislation on waste and to promote a high level of collection and recycling of waste batteries and accumulators.

It seeks to improve the environmental performance of batteries and accumulators and of the activities of all economic operators involved in the life cycle of batteries and accumulators, e.g. producers, distributors and end-users and, in particular, those operators directly involved in the treatment and recycling of waste batteries and accumulators.

- Directive (EU) 2019/883 of the European Parliament and of the Council of 17 April 2019 on port reception facilities for the delivery of waste from ships-This Directive aims to protect the marine environment against the negative effects from discharges of waste from ships using ports located in the Union, while ensuring the smooth operation of maritime traffic, by improving the availability and use of adequate port reception facilities and the delivery of waste to those facilities.
- End of life vehicles – (EU) 2018/849- This Directive lays down measures which aim, as a first priority, at the prevention of waste from vehicles and, in addition, at the reuse, recycling and other forms of recovery of end-of life vehicles and their components so as to reduce the disposal of waste, as well as at the improvement in the environmental performance of all of the economic operators involved in the life cycle of vehicles and especially the operators directly involved in the treatment of end-of life vehicles.

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- Packaging and packaging waste -Directive (EU) 2018/852-This Directive aims to harmonize national measures concerning the management of packaging and packaging waste in order, on the one hand, to prevent any impact thereof on the environment of all Member States as well as of third countries or to reduce such impact, thus providing a high level of environmental protection, and, on the other hand, to ensure the functioning of the internal market and to avoid obstacles to trade and distortion and restriction of competition within the Community.
- Disposal of Animal Waste – EU Directive 90/667/EEC- This Directive lays down:
 - (a) the animal and public health requirements for the:
 - (i) disposal and/or processing of animal waste in order to destroy pathogens which might be present in such materials,
 - (ii) production of feeding stuffs of animal origin in such manner as to prevent the presence of any pathogens therein;
 - (b) the rules for the placing on the market of animal waste intended for purposes other than human consumption.

11.3 Other EU directives that have been adopted as audit criteria in waste management audits consist of:

- Ambient Air Quality and Cleaner Air for Europe – EU Directive 2008/50/EC: This Directive lays down measures aimed at the following:
 - defining and establishing objectives for ambient air quality designed to avoid, prevent or reduce harmful effects on human health and the environment as a whole;
 - assessing the ambient air quality in Member States on the basis of common methods and criteria;
 - obtaining information on ambient air quality in order to help combat air pollution and nuisance and to monitor long-term trends and improvements resulting from national and Community measures;

Audit Criteria at the International Level

- ensuring that such information on ambient air quality is made available to the public;
- maintaining air quality where it is good and improving it in other cases;
- promoting increased cooperation between the Member States in reducing air pollution.
- Assessment of the effects of certain plans and programmes on the environment – EU Directive 2001/42/EC - The objective of this Directive is to provide for a high level of protection of the environment and to contribute to the integration of environmental considerations into the preparation and adoption of plans and programmes with a view to promoting sustainable development, by ensuring that, in accordance with this Directive, an environmental assessment is carried out of certain plans and programmes which are likely to have significant effects on the environment.
- Urban wastewater Treatment – EU directive 98/15/EC- This Directive concerns the collection, treatment and discharge of urban wastewater and the treatment and discharge of waste water from certain industrial sectors.

The objective of the Directive is to protect the environment from the adverse effects of the abovementioned wastewater discharges.

11.4 ISO Standards: These Standards are the distilled wisdom of people with expertise in their subject matter and who know the needs of the organizations they represent – people such as manufacturers, sellers, buyers, customers, trade associations, users or regulators.

ISO 9001- ISO 9001 sets out the criteria for a quality management system and is the only standard in the family that can be certified to (although this is not a requirement). It can be used by any organization, large or small, regardless of its field of activity. In fact, there are over one million companies and organizations in over 170 countries certified to ISO 9001

ISO 14001-ISO 14001 sets out the criteria for an environmental management system and can be certified to. It maps out a framework that a company or organization can follow to set up an effective environmental management system.

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ISO 45001- ISO 45001 specifies requirements for an Occupational Health and Safety (OH&S) management system, and gives guidance for its use, to enable organizations to provide safe and healthy workplaces by preventing work-related injury and ill health, as well as by proactively improving its OH&S performance.

Appendix 1

Internal Audit Checklist on Bio-Medical Waste

Name of the Hospital

Address of the Hospital

No. of Beds

Date

Basic Requirement for Biomedical Waste					
S. No.	Check	OT	LR	ICU/ NICU	Lab
1	Adequate no. of BMW Bins as per BMW Guideline (Red, Yellow, Blue and Black) & Green Bins for general waste	Yes/ NO	Yes/ NO	Yes/ NO	Yes/ NO
2	Adequate no. of BMW Bags as per BMW Guideline (Red, Yellow, Blue and Black) & Green Bins for general waste	Yes/ NO	Yes/ NO	Yes/ NO	Yes/ NO
3	Puncture proof containers for sharps/ Blue Bags	Yes/ NO	Yes/ NO	Yes/ NO	Yes/ NO
4	Mutilators (needle/ syringe cutters)	Yes/ NO	Yes/ NO	Yes/ NO	Yes/ NO
5	Calibrated weighing machine for BMW	Yes/ NO	Yes/ NO	Yes/ NO	Yes/ NO
6	Personal protected equipment's like Gloves, Caps, Masks, Aprons & Gum boots etc as per BMW guideline	Yes/ NO	Yes/ NO	Yes/ NO	Yes/ NO
7	1% fresh Sodium hypochlorite or Bleaching Powder Solution As per BMW Guideline	Yes/ NO	Yes/ NO	Yes/ NO	Yes/ NO
8	BMW Record Register	Yes/	Yes/	Yes/	Yes/

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		NO	NO	NO	NO
9	Mercury Spill Management, kits	Yes/ NO	Yes/ NO	Yes/ NO	Yes/ NO
10	Blood spill Management kits	Yes/ NO	Yes/ NO	Yes/ NO	Yes/ NO
11	Post exposure Prophylaxis Kits	Yes/ NO	Yes/ NO	Yes/ NO	Yes/ NO
12	BMW Storage Rooms With Lock & Key	Yes/ NO	Yes/ NO	Yes/ NO	Yes/ NO
13	BMW Licenses under State Pollution control Board	Yes/ NO	Yes/ NO	Yes/ NO	Yes/ NO
14	Different Forms & Formats (Needle Stick Injury & Annual Report, etc.)	Yes/ NO	Yes/ NO	Yes/ NO	Yes/ NO
15	Injury Register	Yes/ NO	Yes/ NO	Yes/ NO	Yes/ NO
16	Investigation and Follow up schedule for injuries	Yes/ NO	Yes/ NO	Yes/ NO	Yes/ NO
17	BMW Generation register at Point of Generation	Yes/ NO	Yes/ NO	Yes/ NO	Yes/ NO
18	BMW Generation register at Temporary waste storage room	Yes/ NO	Yes/ NO	Yes/ NO	Yes/ NO
Manpower for BMW					
1	Availability of a trained dedicated person for BMW management	Yes/ NO	Yes/ NO	Yes/ NO	Yes/ NO
2	Trained and skilled BMW person for BMW collection & transportation	Yes/ NO	Yes/ NO	Yes/ NO	Yes/ NO
3	Dedicated & Trained Infection	Yes/	Yes/	Yes/	Yes/

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	Controlled Nurse	NO	NO	NO	NO
Occupational Safety Measures					
1	Whether all the manpower been Immunized with Hepatitis B and Tetanus?	Yes/ NO	Yes/ NO	Yes/ NO	Yes/ NO
2	Whether immediate care is taken or post exposure prophylaxis is used when there is a needle stick injury/blood & body fluid exposure?	Yes/ NO	Yes/ NO	Yes/ NO	Yes/ NO
3	Whether the manpower is using appropriate PPE while handling the BMW?	Yes/ NO	Yes/ NO	Yes/ NO	Yes/ NO
4	Whether the manpower is undergoing regular health check-ups?	Yes/ NO	Yes/ NO	Yes/ NO	Yes/ NO
5	Whether waste generation register, injury register, training register, immunisation and health records, monitoring and surveillance records are maintained properly?	Yes/ NO	Yes/ NO	Yes/ NO	Yes/ NO
6	Whether the manpower is aware of the special first aid procedures for different type of injuries or accidental exposure of body fluids?	Yes/ NO	Yes/ NO	Yes/ NO	Yes/ NO
Training for BMW					
1	Whether proper training is being given for the manpower at the entry/ induction?	Yes/ NO	Yes/ NO	Yes/ NO	Yes/ NO
2	Whether the manpower has hands on training and supervisors are monitoring them on regular basis?	Yes/ NO	Yes/ NO	Yes/ NO	Yes/ NO
3	Whether retraining and new technique training is given annually to all the manpower?	Yes/ NO	Yes/ NO	Yes/ NO	Yes/ NO
4	Whether the manpower is trained to	Yes/ NO	Yes/ NO	Yes/ NO	Yes/ NO

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	use which type of PPE while handling different types of BMW?	NO	NO	NO	NO
5	Is the manpower trained to use various tool kits like, mercury spill kit, blood spill kit and etc?	Yes/ NO	Yes/ NO	Yes/ NO	Yes/ NO
Generation & Segregation					
From Wards/ O.Ts/ICUs/ Labs/ OPDs/ Blood Bank/ Radiology etc.					
Generation					
1	Is the waste segregated at the site of generation?	Yes/ NO	Yes/ NO	Yes/ NO	Yes/ NO
2	Is the sharp infectious waste (needles, blades, broken glass etc) to be disposed in white/blue puncture proof containers?	Yes/ NO	Yes/ NO	Yes/ NO	Yes/ NO
3	Is the non-sharp Infectious material: (infected plastics, syringe, dressing, gloves, masks, blood bags and urine bags) to be disposed in red plastic bins/bags?	Yes/ NO	Yes/ NO	Yes/ NO	Yes/ NO
4	Is Anatomical Infectious waste (Placenta, body parts) to be disposed in yellow plastic bins or bags?	Yes/ NO	Yes/ NO	Yes/ NO	Yes/ NO
5	Is non-infectious (General) waste E.g., packing materials. Cartons, Fruit and vegetable pills, Syringe and needle wrappers, Medicine covers to be disposed in Green/Black plastic bins or bags?	Yes/ NO	Yes/ NO	Yes/ NO	Yes/ NO
6	Is the infectious waste and non-infectious waste mixed at the source of generation?	Yes/ NO	Yes/ NO	Yes/ NO	Yes/ NO
7	Is the Liquid waste like Silver X ray film developing liquid, infectious	Yes/ NO	Yes/ NO	Yes/ NO	Yes/ NO

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	liquid waste, Liquid chemical waste from lab disposed to the yellow bins or bags?				
8	Are the expired/ discarded medicines, Cytotoxin drugs disposed to the yellow bins?	Yes/ NO	Yes/ NO	Yes/ NO	Yes/ NO
9	Whether the Foley's Cather, Urosac bags, IV Bottle and Drip set, Heavy duty rubber gloves, surgical gloves, syringe without needle, vacutainer, Ryles tubes disposed in the red bin or bags?	Yes/ NO	Yes/ NO	Yes/ NO	Yes/ NO
Collection & Storage					
1	Is the waste disposed in covered bins?	Yes/ NO	Yes/ NO	Yes/ NO	Yes/ NO
2	Are the bins filled up to more than $\frac{3}{4}$ the level?	Yes/ NO	Yes/ NO	Yes/ NO	Yes/ NO
3	Are the bins cleaned with soap and disinfectant regularly?	Yes/ NO	Yes/ NO	Yes/ NO	Yes/ NO
4	Are the bins overfilled?	Yes/ NO	Yes/ NO	Yes/ NO	Yes/ NO
5	Is the infectious and non-infectious waste filled in same bins?	Yes/ NO	Yes/ NO	Yes/ NO	Yes/ NO
6	Is the stored waste kept beyond 48 hours?	Yes/ NO	Yes/ NO	Yes/ NO	Yes/ NO
7	Whether the storage rooms are hygienically maintained?	Yes/ NO	Yes/ NO	Yes/ NO	Yes/ NO
Transportation					
1	Is the waste transported in closed containers?	Yes/ NO	Yes/ NO	Yes/ NO	Yes/ NO
2	Are the waste collection bins/ trolleys/ wheelbarrow used for transporting waste?	Yes/ NO	Yes/ NO	Yes/ NO	Yes/ NO

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3	Is the pre-defined route available for transportation of waste within the health care facility?	Yes/ NO	Yes/ NO	Yes/ NO	Yes/ NO
4	Is the waste transported in open container and bags?	Yes/ NO	Yes/ NO	Yes/ NO	Yes/ NO
5	Is the transportation done during the OPD time or any Emergency?	Yes/ NO	Yes/ NO	Yes/ NO	Yes/ NO
Treatment & Disposal					
1	Is the bio medical waste disinfected and mutilated before final disposal?	Yes/ NO	Yes/ NO	Yes/ NO	Yes/ NO
2	Is the anatomical waste to be deep buried /incinerated?	Yes/ NO	Yes/ NO	Yes/ NO	Yes/ NO
3	Are the syringes to be cut and chemically disinfected with 1% sodium hypo chloride solution at the source of generation before final disposal?	Yes/ NO	Yes/ NO	Yes/ NO	Yes/ NO
4	Is the infected plastics to be chemically disinfected or autoclaved, shredded and sent for final disposal?	Yes/ NO	Yes/ NO	Yes/ NO	Yes/ NO
5	Is the General waste to be chemically disinfected before final disposal?	Yes/ NO	Yes/ NO	Yes/ NO	Yes/ NO
6	Has the infectious waste been disposed before chemical disinfection and mutilation?	Yes/ NO	Yes/ NO	Yes/ NO	Yes/ NO
7	Has the infectious waste and non-infectious waste been mixed at any point of time?	Yes/ NO	Yes/ NO	Yes/ NO	Yes/ NO
Management of Different Waste Streams					
1	Has any sharp injury reported and is it reported within 7 hours. If yes, then please mention the count per month?	Yes/ NO			

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2	Are the protective gears like gloves used while handling syringes?	Yes/ NO		
3	Is the barrel and plunger detached before disinfecting the syringe?	Yes/ NO		
4	Is the sharp waste mixed with other waste?	Yes/ NO		
5	Is the practice of recapping or bending of needles done?	Yes/ NO		
6	Is the sharp discarded in poly bags?	Yes/ NO		
7	Is the sharp disposed in open area?	Yes/ NO		
8	Are the vials and ampoules disposed in sharps container?	Yes/ NO		
9	Is the anatomical waste disinfected before final disposal?	Yes/ NO		
10	Is the anatomical waste disposed in unsecured open areas or in any water bodies?	Yes/ NO		
11	Are the personal protective gears like mask and gloves used while handling sputum cups and slides?	Yes/ NO		
12	Is the sputum cup or slides disinfected with <u>5 % hypochlorite solution for at least one hour?</u>	Yes/ NO		
13	Are the sputum cups finally disposed inside the premises or outside the premises?	Yes/ NO		
14	Are the slides of the Sputum test disposed in sharps container?	Yes/ NO		
15	Are the discarded blood bags punctured before disinfection in 5 % sodium hypochlorite solution for at least 1 hour?	Yes/ NO		
16	Is the blood bag discarded without	Yes/ NO		

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	mutilation and disinfection for final disposal?	
17	Is the plastic waste like IV set, bottles, syringes, latex gloves, catheters etc. cut by scissors before disinfection in 1% sodium hypochlorite solution for 1 hour?	Yes/ NO
18	As the disposable gloves and masks reused?	Yes/ NO
19	Is liquid waste spillage (blood, body fluid puss or any discharge) disinfected by adding 1% hypochlorite solution before cleaning?	Yes/ NO
20	Is the blood spill cleaned cloth reused?	Yes/ NO
21	Is the mercury spill cleaned with bare hands?	Yes/ NO
22	Is the mercury disposed in waste bins and drains?	Yes/ NO
23	Is the mercury collected into bottle having some water and tightly covered with the lid	Yes/ NO
24	Is the mercury droplet collected using 2 cardboard piece /Syringe	Yes/ NO
25	Is the hand washing done before and after any procedure. E.g., collecting lab sample, examination of the patient, handling blood and body fluid?	Yes/ NO
26	Are all staff immune to hepatitis B and tetanus vaccine?	Yes/ NO

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27	Do the hospital personnel visit the final disposal site even if outsourced or done outside the hospital?	Yes/ NO
28	Whether the medicine and chemicals stored in same store?	Yes/ NO

Observer's Signature

Date

Appendix 2

Environmental Management Audit and Regulatory Compliance–Model Checklist

Location Date.....

1.0	General - including staff awareness
1	What steps have been taken to publicise the Organisation's Environmental Management System and Environmental Policy?
2	Are details of the EMS available? (via Intranet/Internet, posters, leaflets, in-house magazine, training, local procedures etc.)
3	Are staff aware of the EMS and their roles and responsibilities?
4	Are staff encouraged to play an active part in improving the Organisation's environmental performance?
5	Have staff undertaken adequate training e.g., Mandatory, Induction, specific training (examine training records)
2.0	Air Emissions
1	What potential or actual sources of polluting emissions to atmosphere are there? (These would include chimney stacks from boilers and incinerators, exhaust from CHP plant, medical gases, halon firefighting systems, fume cupboard extracts and potential Legionellae breeding sites such as evaporative cooling towers - none in Organisation)
2	Does the site comply with relevant legislation
3	Are monitoring, maintenance and control procedures adequate?
3.0	Aqueous Emissions
1	What is the risk of contaminating storm water drainage by spillages of chemicals, fuels etc?
2	In the event of fires in chemical or materials storage areas, could fire sprinkler water contaminate the storm drains? (LGF at UHW only)

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3	Are any environmentally harmful wastes disposed of to a sewer (e.g., mercury amalgam, radioisotopes, solvents)?
4	Are there adequate safeguards to prevent pollution of ground or surface waters by site effluents?
5	Are there storm and foul water drainage systems drawings for the site, and is the identification of each known?
6	Have gullies, grids and manhole covers been colour coded to aid identification (blue for surface water, red for foul)
7	If interceptors are fitted when were they last cleaned out?
8	Is the integrity of the bunding arrangements regularly checked?
9	Are there spillage kits in close proximity to the place where hazardous substances are stored?
10	Are instructions for dealing with spillages readily available?
4.0	Dangerous Substances and Incidents
1	Are any potentially hazardous materials stored or used (e.g., fuel, pesticides, drugs, chemicals, flammable and toxic substances)?
2	Are there adequate safeguards to prevent their escape into the environment? (e.g., containment measures such as bunding, interceptors etc)
3	What is the risk of contaminating storm water drainage by spillages of chemicals, fuels etc?
4	Are there spillage kits in close proximity to where hazardous substances are stored?
5	Are instructions for dealing with spillages readily available?
6	Are there contingency plans in place for dealing with emergencies?
7	Are contingency plans tested?
5.0	Noise and Nuisance
1	Have there been any complaints about the site from neighbours or the general public?
2	Have there been any problems with the local authority, Environment Agency or any other regulatory authority?
3	What records are kept regarding complaints?

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4	Who deals with complaints and what procedures are followed?
6.0	Planning (incl. Site, Land, Buildings Issues)
1	Are there any Tree Preservation Orders - TPO's on the site and how are they managed?
2	Are there any Listed Buildings on the site and how are they managed?
3	Does the site have any environmental sensitivities, such as proximity to rivers, lakes, forests, townships, rare habitats etc?
4	Have Building Regulations approval been granted for building / development works?
5	Have there been any complaints about the site from neighbours or the general public?
6	Have there been any problems with the local authority, Environment Agency or any other regulatory authority?
7	What records are kept regarding complaints?
8	Who deals with complaints and what procedures are followed?
9	Is there an up-to-date site plan showing site boundaries, site orientation, plant layout, drainage systems, etc?
10	Are all utilities clearly identified?
11	Are there regular site inspections by management?
12	Are there plans for new developments and how are they progressing?
13	Have the environmental effects of these plans been adequately assessed? [e.g., formal Environmental Impact Assessments
14	Is there scope for improving the site by landscaping, tree planting, creation of lawns, lakes and amenity areas?
15	Where are the main storage areas for materials, especially hazardous substances and fuels?
16	What procedures are in place for coping with fires, spillages and other emergencies?

Appendix 2

17	Have there been any previous pollution incidents on the site and, if so, how were they handled?
18	Has there been any damage to the local environment which can be traced directly to the site activities?
7.0	Resource Consumption (incl. Use of Energy)
1	Does the Procurement/ Purchasing process incorporate environmental clauses in the contract/ supplier documentation?
2	Is the environmental performance of suppliers monitored?
3	Are any of these associated with particular environmental problems during their life cycle? (e.g., tropical hardwoods, CFC, paper etc.)
4	Are more environmentally preferable alternatives available?
5	Could these alternatives be used?
6	Is there any scope for reducing levels of consumption?
7	Are consumption levels adequately monitored at present?
8	Does the Department currently purchase recycled paper for photocopying or personal computer printers?
9	Does the Department currently purchase other recycled office stationery?
	USE OF ENERGY
10	What are the main forms of energy used?
11	Is energy consumption adequately monitored? (Ideally, monitored separately for different buildings, departments or functions)
12	Has any significant effort been put into energy conservation?
13	What specific steps have been taken to reduce its energy consumption and to ensure that use of energy is as efficient as possible?
14	Have any energy utilisation surveys been undertaken, or detailed advice provided on how to reduce energy consumption recently? (i.e., within the last 3 years)
15	Who is responsible for reporting problems of energy use and supply to the Estate Maintenance Help Desk?

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16	Is energy efficiency positively promoted via a Good Housekeeping Scheme?
17	Are there up to date 'switch it off' stickers and posters for lighting and electrical equipment?
18	Has investment been made in energy efficient schemes recently? (i.e., within the last 3 years)
19	Are individual staff encouraged to be responsible for their own energy use?
20	Are employees positive concerning energy reduction and aware of their role and responsibility?
21	Are environmental issues considered when purchasing fuels? (i.e., gas instead of oil, etc.)
22	Does the monitoring regime in place highlight notable exceptions to normal performance?
23	Are the necessary management arrangements in place to support the delivery of effective energy management?
24	Is there scope for further initiatives?
	USE OF WATER
25	What are the main uses for water?
26	Is the consumption adequately monitored?
27	Is there potential for reducing water consumption?
28	What specific steps have been taken to reduce its water consumption and to ensure that use of water is as efficient as possible [Examples include push taps, low flush toilets, urinal controls]
29	Are there adequate safeguards to prevent pollution of the mains supply (e.g., by siphoning back)?
30	Has any significant effort been put into water conservation?
31	Is water efficiency positively promoted via a Good Housekeeping Scheme? (Posters, stickers, training etc)
32	Who is responsible for reporting problems of water use and supply to the Estate Maintenance Help Desk?

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33	Have any water utilisation surveys been undertaken recently? (i.e. within the last 3 years)
34	Has investment been made in water efficient schemes recently? (i.e., within the last 3 years)
35	Does the monitoring regime in place highlight notable exceptions to normal performance?
36	Are employees positive concerning water reduction and aware of their role and responsibility?
37	Are the necessary management arrangements in place to support the delivery of effective water management?
38	Is there scope for further initiatives?
8.0	Risk
1	Where are the main storage and collection areas for materials, especially hazardous substances and fuels?
2	What is the risk of contaminating storm water drainage by spillages of chemicals, fuels etc?
3	What procedures are in place for coping with fires, spillages and other emergencies?
4	Have there been any previous pollution incidents on the site and, if so, how were they handled?
5	Where are the main storage and collection areas for materials, especially hazardous substances and fuels?
6	Are there suitable spillage kits readily available to contain potential spillages?
7	Have staff undergone training in the proper use of spillage kits?
8	Is there an adequate monitoring and maintenance regime in place to manage the risks posed by Legionella?
9	Is the monitoring and maintenance regime independently audited by a specialist consultant?
10	Is there an Asbestos Register identifying all known ACMs in premises?

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9.0	Transport
1	Does the site own or operate any vehicles?
2	Are these managed in such a way as to maximise fuel economy?
3	Is there any potential to reduce the number of miles driven (e.g. better route planning, avoiding unnecessary journeys etc.)?
4	Is there potential to convert existing vehicles to greener fuels (e.g., LPG, CNG, ULSD etc.)?
5	Does the site have a published Sustainable Transport Plan?
6	Is there a Transport Manager whose role is to co-ordinate all transport activities?
7	Has a travel to work survey been undertaken amongst staff to establish attitudes and transport patterns for the site?
8	Is secure cycling storage provided, together with lockers and showering facilities for staff?
9	How is the site served with public transport facilities? (e.g., bus services and stops, railway stations, taxi ranks etc.)
10	Is there any fee levied for on-site parking?
11	Is there up to date information and timetables provided for all public transport providers readily available for staff and visitors?
10.0	Waste
1	What wastes are produced?
2	How are they disposed of?
3	Is there a formal waste policy and strategy for the site?
4	Is the Organisation's Waste Management Policy and Operational Procedures available to staff carrying out waste disposal?
5	Have waste audits been carried out to identify and monitor all waste arisings on the site?
6	Are staff aware of the requirements for waste management under the respective acts
7	Is the disposal service for toxic and flammable waste chemicals provided by Procurement via the Toxic and Flammable Waste Store used?

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8	Are records of waste consignments available and up to date? (Records for 3 years must be retained)
9	Are there suitable procedures and facilities for segregating and handling clinical waste and other potentially harmful wastes (e.g., solvents, toxic, special waste etc.)?
10	Are there up to date waste management posters and procedures available in prominent locations e.g., waste rooms, staff rooms etc.?
11	Does the site comply with the requirements of the Various Acts relating to waste management?
12	Are suppliers of goods and services encouraged to reduce packaging or to take empty packaging back for re-use?
13	Are there opportunities for reducing the quantity of waste produced?
14	Have the Organisation's systems for advertising or acquiring redundant equipment made use of?
15	Is there a waste manager whose role is to co-ordinate all waste management activities?
16	Are appropriate waste records e.g., Authorisations, Carriers Certificates of Registration, Hazardous Waste Regulations Consignment Notes, Annual Transfer Notes, Waste Transfer Notes, 'Duty of Care' documentation and audit, Permits, Licences - waste management, Method Statements etc. available and in order
17	Are there opportunities for recycling of the following wastes produced: <ul style="list-style-type: none"> • Paper • Cardboard • Aluminium / Steel cans • Glass • Printer toner cartridges • Plastics • Furniture • Wood • Other (specify)

Auditor's Signature

Date

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