CDC
Investment works

Waste Guidance Note

About this Guidance Note

As CDC continues to promote private sector development and the building of businesses in emerging markets, it is important to recognise the growing need to manage and encourage sustainable solutions to solid waste management across these markets. Assessing this is also crucial in driving improved practices in resource efficiency, as well as addressing the implications of waste management from a public health and environmental perspective.

Waste is an integral part of environmental and social (E&S) responsibility and across CDC's investments effective waste management remains a consistent and key component of E&S performance management. Implementing sustainable waste management solutions continues to present a challenge across emerging markets, for instance due to the scarcity of recycling facilities and limited capacity to handle hazardous wastes in many markets.

This Guidance Note, which is aimed at companies and fund managers in emerging markets, sets out the context of waste management across CDC's countries of focus, outlining current practices and trends, and highlighting some of the common constraints that companies experience. The note identifies opportunities to drive improved waste management practices, and shares case studies of where these have been implemented in practice.

The Guidance Note focuses on CDC's key sectors of agribusiness, healthcare, construction and manufacturing, and aims to provide a contextual analysis from selected countries including Nigeria, Ghana, Kenya, Tanzania, Malawi, Zambia, India and Bangladesh. Information has been drawn from desktop review and interviews across CDC's portfolio.

To supplement this Guidance Note, CDC has also developed a series of waste management tools that provide further detailed guidance for operational decision-making. These are designed across seven key waste streams and are available on CDC's website.

Setting the scene

> By almost any form of evaluation, solid waste management is a growing environmental and financial problem in emerging markets.[1]

In recent years, there has been a significant increase in the generation of solid waste, with serious economic, health and environmental impacts. Various factors are causing this increased waste generation and associated risks, including:

- urbanisation;
- new waste streams (such as e-waste and plastic);
- weak regulation and enforcement of waste regulations; and
- rise in disposable income.

Existing research identifies the rapid surge in waste volumes as straining waste-management systems in many developing countries, with negative effects on economics, health and ecosystems.[2]

Globally, 1.3 billion tonnes of municipal waste are generated annually, and waste generation is expected to increase to 2.2 billion tonnes by 2025.[3] The World Bank estimates that the volume of waste generated will double in the next 20 years in low and lower-middle income countries.

The challenges in implementing sustainable waste management practices are well recognised by CDC, particularly as the collection, transportation, treatment and disposal of waste can be costly in financial terms. In addition, a significant percentage of the countries in which CDC operates do not have the infrastructure or resources to appropriately manage waste, which coupled with the absence or weak enforcement of the existing legislative framework makes the challenge more acute.

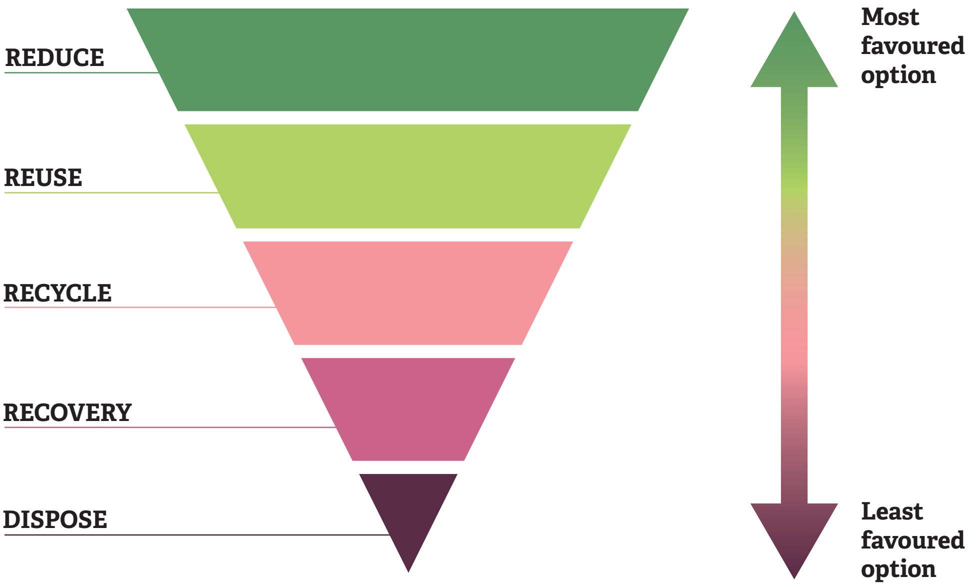
In 2016, the Central Pollution Control Board in India estimated that burning solid waste contributed to between 5% and 11% of particulate matter emissions in urban areas leading to higher rates of respiratory disease.

Moreover, a significant focus of waste management in emerging markets is on municipal waste while data and information available on commercial and industrial waste, an area of core relevance to CDC, is extremely limited.

There are sound business reasons in favour of sustainable waste management practices. These not only focus on waste as an end product – seen through the lens of disposal and treatment needs – but also focus on opportunities to reduce waste generation and drive resource efficiency improvements, following the waste management hierarchy presented in Figure 1 and aligning with the principles of circular economy.

Taking a proactive approach to waste management brings multiple benefits to companies including reduced operational and capital expenditure, reputational risk and financial and legal liability.

Figure 1. *Waste management hierarchy*



Key facts on the intrinsic value in waste

Kilo for kilo, there's more gold in electronic scrap than in gold ore.

Collecting and selling used polyethylene terephthalate (PET) bottles can earn a waste picker a living (US$3.50 a day).

Every metric ton of used clothing collected could generate revenue of US$1,975, if garments were sold at current secondary-market prices, comfortably outweighing the cost of US$680 needed to collect and sort each metric ton.

[1]

Sector overviews

The following sections give an overview of the four key sectors (healthcare, agribusiness, construction and manufacturing), characterising their key waste streams, outlining existing practices and providing practical solutions and examples of good practice.

Healthcare

Key waste streams

Between 75 and 90% of the waste produced by healthcare facilities is non-hazardous general waste generated mostly from administrative, kitchen and housekeeping activities, and areas open to the public. This component of healthcare waste stream can be segregated and treated along with other non-hazardous waste. As such, it is not the focus of this part of the healthcare sector guidance.

The other 10 to 25% is categorised as hazardous and poses various environmental and health risks requiring particular management. Figure 2 shows classifications of hazardous healthcare waste.[a]

Figure 2. *Healthcare hazardous waste streams*

[a] Another commonly used classification developed by the World Health Organization (WHO) is: infectious waste, pathological waste, sharps, chemicals, pharmaceuticals, genotoxic waste, radioactive waste, and non-hazardous or general waste.

Snapshot of current practices

All the countries analysed as part of this Guidance Note have strict, tightly controlled legislative frameworks that are largely designed in line with international requirements. Yet implementing these is largely the responsibility of local, municipal or state authorities, who often lack the means and resources to manage this waste stream. There is also a widespread lack of safe disposal infrastructure, technologies and market-led service provision.

Incineration is one of the most common options used to dispose of hazardous healthcare waste. However very basic combustion units (single chamber incinerators or drum incinerators), which generate fly ash, smoke, toxic flue gas (contaminated also by dioxins and furans) and odours and are not able to effectively destroy trace chemo and pharmaceutical waste, are often used in low-income countries.[4]

In Tanzania, Kenya, Ghana and Nigeria, small private and public medical practices, including those in rural areas, are required to transport their waste to regional centres or large cities where onsite incineration technology, based at larger, national hospitals can be used. Complying with legislation and regulations therefore leads to transport and waste handling costs, which can be significant.

In India, overall spending on healthcare is growing rapidly, but 70% of services are private and largely concentrated in urban, higher-income areas. The prevailing cost of hazardous waste management in hospitals in India stands at around 10–12 Indian rupees per bed per day, equivalent to about US$25,000 per year for a 400-bed hospital. Medical waste infrastructure and services are largely confined to tier 1 cities.[5] Non-compliance and infrastructure gaps are widespread: the Ministry of Environment and Forests for example stated in 2011 that 13,037 healthcare facilities were violating the Bio-Medical Waste (Management and Handling) Rules, 1998.[6]

Bir Hospital, Kathmandu, Nepal

Waste collected from wards is transported to a special waste treatment and storage facility. The facility includes: a bio-digester for food waste and a public mercury collection house for drop-offs of thermometers and internal use. The facility also runs a programme through which patients that require physioterapy are trained to make handicrafts from recycled plastic.[8]

The way forward

The first measure for reducing the volume of hazardous waste, and therefore the cost for its treatment, as well as the accident rate[b] among healthcare workers, is ensuring hazardous and general waste fractions are appropriately separated. Buying reusable equipment and hospital materials (where legal and safe) also reduces the volume of single-use materials that need to be disposed of.

Equipment containing hazardous chemicals, such as mercury in thermometers and radioactive substances (eg x-rays) could be replaced with digital versions of the same equipment. The 'first-in-first-out' method[c] also helps to minimise the volume of pharmaceutical waste, such as expired medicines and chemicals, that needs to be disposed of.

Some hospitals and health facilities in Africa and Asia have started investing in incineration technology or forming partnerships with local institutions and companies that can safely incinerate hazardous wastes on their behalf. Using high-heat thermal systems (eg dual or multi chamber incinerators or rotary kilns, also called pyrolytic incinerators, see the first two rows in Table 1) that involve combustion or pyrolysis of medical waste at temperatures between 800 and 1,200˚C is normally considered the safest method for disposing of hazardous medical waste globally. Even so, certain medical wastes (eg radioactive and cytotoxic waste[d]) need special consideration and treatment such as extremely high temperatures (more than 1,200˚C) to ensure appropriate destruction of cytotoxic materials. Table 1 shows the most common models – please note not all are recommended.[9]

Bagamoyo District Hospital, Tanzania

Since October 2008, this hospital has been using an onsite autoclave and shredder to clean and shred their waste, rendering their hazardous waste non-hazardous and ready for general disposal or recycling.

b It is estimated that more than two million healthcare workers are exposed to percutaneous (ie through the skin) injuries with infected sharps every year and those might lead to contracting hepatitis and HIV infections. In the year 2000, sharps injuries to healthcare workers were estimated to have caused around 66,000 cases of hepatitis B, 16,000 of hepatitis C and between 200 and 5,000 HIV infections.[7]

c This method involves the careful labelling of products that expire, so those that expire soonest are used first (as far as is possible/practical) before their expiry, and before using newer stock with longer expiry dates.

d Waste produced during cancer treatments.

Table 1. Common models of incinerators

Type of incinerator	Advantages	Disadvantages	Adequate for:
Pyrolitic incineration 	• Very high disinfection efficiency • Low cost models available • Drastic reduction of weight and volume of waste • The residues may be disposed of in landfills	• Incomplete destruction of cytotoxics • Relatively high investment and operating costs • Competent staff needed	• All infectious waste • Most pharmaceutical waste • Most chemical waste
Single-chamber incineration 	• Good disinfection efficiency • Drastic reduction of weight and volume of waste • The residues may be disposed of in landfills • No need for highly trained operators • Relatively low investment and operating costs	• Significant emissions of atmospheric pollutants • Need for periodic removal of slag and soot • Inefficiency in destroying thermally resistant chemicals and drugs such as cytotoxics	• General non-hazardous healthcare waste • Infectious waste • Produces significant emissions
Drum or brick incineration 	• Drastic reduction of weight and volume of the waste • Very low investment and operating costs	• Cannot destroy all microorganisms • Does not destroy many chemicals and pharmaceuticals • Significant emission of black smoke, fly ash, toxic flue gas, and odours	• General non-hazardous healthcare waste • Only in emergency situations

Practical tips: 10 points to consider when incinerating hazardous healthcare waste

1. Anticipated hazardous waste volumes generated and forecasted (in the near term)
2. Waste separation practices in place and ability to develop and implement effective waste segregation
3. Capacity of incinerator needed
4. Availability of space
5. Availability and access to technical staff who can manage and operate the incinerator (including de-ashing and monitoring)
6. Availability of materials to build the incinerator
7. Local laws and regulations
8. Type of fuel (if needed)
9. Restrictions on air emissions
10. Alternative options available (for instance through collaboration with other institutions or third parties)

Agribusiness

Key waste streams

The key waste streams generated in the agribusiness sector include organic (natural and processed)[e] and hazardous chemical waste. These form the focus of this section, given the high volumes generated (organic waste), and the pertinent environmental and health risks posed by hazardous chemical waste. For hazardous waste, the use of plastic containers for agrochemicals (for example pesticides and herbicides) is identified as one of the most pressing challenges in the sector largely due to lack of facilities to manage it, particularly where agribusinesses are operating in remote locations.

Other waste streams generated in the agribusiness sector include mixed recyclables (eg paper, metal and glass) and other types of hazardous waste such as biomedical waste (animal carcasses) and electronic waste. Figure 3 shows the most common wastes in the sector.

e Natural organic waste: principally by-products of primary production in agribusiness, including leaves, tree branches, stalks, roots and soil left over from harvesting. Processed organic waste: food waste and organic material from economic activities including agriculture, horticulture and food processing facilities. This doesn't include carcasses or animal matter from abattoir activities for example, which would typically be treated under hazardous waste.

Figure 3. Agribusiness waste streams

Snapshot of current practices

Apart from general reference to the promotion of composting and use of organic fertilisers across selected legislation, legislative frameworks do not generally address agricultural waste. The exception is mixed hazardous waste; which falls under the stricter regulations that govern management of disposal of general hazardous waste.

Various studies outline the impacts on human health of improper waste management practices in agribusiness, which are largely driven by the use of hazardous agrochemical containers by local populations to store and carry drinking water.[10] Furthermore, organic waste, generally the largest percentage of agribusiness waste streams, has the potential to generate significant greenhouse gas emissions, while 'wet' organic materials can contaminate other materials, reducing their recycling value. The recovery of one metric tonne of organic waste for example can save up to 868kg of CO_2e/t[f] according to the US Environmental Protection Authority.

f A carbon footprint is measured in tonnes of carbon dioxide equivalent (tCO_2e)

There are opportunities to reuse and recycle across the agribusiness sector given the organic nature and natural breakdown of many of the waste outputs. But agribusinesses operating in sub-Saharan Africa highlight that the absence of adequate infrastructure and services from governments acts as a barrier for the uptake of sustainable organic waste management practices. They note, though, that particularly for larger-scale agribusiness there are opportunities to develop and implement composting practices onsite, as well as explore energy-generating opportunities.

Mixed hazardous waste streams present the most significant challenges for company management, largely because recycling or safely disposing of these waste types in the absence of supporting infrastructure is extremely complex. Furthermore, the vast majority of businesses operating in commercial agriculture are located in remote areas where third-party service providers and supporting infrastructure are rarely available, presenting logistical and financial barriers for managing hazardous waste typologies.

> "The reuse and recovery potential of our organic agribusiness activities, solid waste recycling efforts and sawmill in Sierra Leone have inspired us to set our vision on a zero-waste goal."
>
> **Stephanie Doig – Miro Forestry**

The way forward

Organic waste

Some advanced methods of organic waste management present economic and technical challenges in respect of the skills they require and costs they incur. But there are also a host of simple solutions such as composting and small-scale anaerobic digesters, which deliver further benefits by generating biogas for domestic use in many instances.

As a first step it is important to store natural organic waste in a dry, clean and segregated area to prepare for use onsite or for third-party composting and energy-generating activities. Due to the high density and moisture content of organic waste, it is not normally cost efficient to transport products beyond a 15km radius from where they are produced.

Composting

The vast majority of composting activities that companies undertake are centred on the use of organic waste (derived for example from crop and plant residues and animal manure). Processed organic waste is ideal for composting activities and it is easily broken down into compost, using traditional composting methods or advanced rapid decomposition methods such as EM-1 composting or larvae/black soldier fly farming.[g] Some companies may prefer to adopt composting practices simply to mitigate the environmental impact and waste collection expenses of managing organic waste.

Waste to energy

Anaerobic digesters are used successfully all over the world to turn manure, plant waste and food scraps into biogas, and the digested slurry (digestate) produced from anaerobic digestion (AD) can also be used as fertilizer.

The digesters have different capacities and should be selected based on the volumes of waste being generated by the operations. Note that large anaerobic digester plants (above 1 tonne of waste per day) need advanced engineering skills to operate and often include significant CAPEX requirements (estimates in India for the construction of a 1 tonne per day anaerobic digesters plant are around US$40,000).

For small-scale anaerobic digesters, investment costs are moderate and semi-skilled and skilled workers are likely to be able to operate them (though installation requires skilled labour and expert design). Both biogas and fertilising sludge are of value, thus making biogas digesters interesting from an economic point of view.[11]

Sawdust and woodchips can be used in various waste-to-energy applications at scale, without the need for advanced technology or engineering capacity. For example, burning sawdust waste as a heat source for producing ceramic products, or to 'smoke' preserved foods (eg meats, fish).

Gorge Farm Energy Park

Gorge Farm in Naivasha, Kenya is an 800-hectare vegetable farm owned and operated by the VP Group, the largest fresh-produce exporter in East Africa. The farm has an anaerobic digestion plant that processes agricultural waste (reported to use 150 tonnes of fresh organic matter per day), producing energy for electricity with up to a 2.4-megawatt output. Organic residue from the digestion process is used on the farm instead of chemical fertiliser.

g EM-1 uses a combination of anaerobic microbes that work to ferment rather than immediately decompose waste. It can be largely run as an anaerobic process, with low cost and input requirements. Black soldier fly larvae are used to compost organic waste and can also be used to convert the waste into animal feed. Pilots using the larvae are inexpensive to set up and have almost no operating or maintenance costs once operational. The composting method can process up to 80kg of processed food waste per day and mitigate the costs and carbon impact of managing organic waste via less sustainable methods (eg dumping).

Mixed hazardous waste – hazardous chemical waste

Agricultural operations should consider using integrated pest management as an opportunity to eliminate or significantly reduce the use of pesticides and keep the toxicity of, and exposure to, any agrochemical products as low as possible. This focuses on combining available biological, genetic and agricultural methods to combat pests, rather than applying pesticides extensively.[12]

Where hazardous chemical waste, which includes agrochemical waste containers, is generated it is first vital to make sure there is a system to separate and safely store hazardous chemical wastes from general waste. Additional options for reducing hazardous chemical waste are outlined in the box.

How to reduce hazardous chemical waste

- Label, record and carefully monitor all chemicals to ensure that expiry and use by dates are safely and effectively managed. This also reduces disposal losses of chemicals not used before expiry. It is important to also refer to Material Safety Data Sheets that contain information on safe disposal methods.
- Only mix or use the exact amount of solution needed for hazardous chemicals.
- Engage suppliers regularly to investigate (non-hazardous) alternatives to commonly needed chemical products and the potential for suppliers to take back unused products or packaging to reduce waste. If necessary, investigate the use of alternative suppliers.
- Determine whether natural and non-hazardous fertiliser or agrochemical alternatives can be sourced and comply with company requirements.

Plastic containers that have previously been used to store hazardous chemicals are also normally considered to be hazardous waste. To mitigate the requirement to dispose of plastic as a hazardous waste type, it is often possible to either reuse the container (ie for storage of similar hazardous chemicals) or treat the plastic container waste for recycling after 'triple-rinsing.[h]

SilverStreet Capital

SilverStreet Capital, a pan-African agribusiness investor, has trained employees across all its agribusiness operations on triple rinsing of chemical containers. Its operations teams are in discussion with agrochemical suppliers to encourage them to share responsibility for disposing of the empty containers, potentially including a supplier take-back scheme. Due to the lack of suitable hazardous waste service providers in the country, its Tanzanian investment, Silverlands Tanzania, has invested in a chipping machine to significantly reduce waste volumes onsite after triple rinsing.

h Triple-rinsing is a three-stage manual rinsing process proven as the best method for cleaning empty agrochemical containers. It means rinsing the container three times, and can be used with plastic, non-pressurised metal and glass containers.[13]

Plastic can also be crushed or shredded and treated through float separation and a wastewater treatment unit, after which it can be recycled.

Construction

Key waste streams

The construction sector includes property developers and construction and demolition enterprises. Construction and demolition waste typically forms the heaviest and most voluminous category of waste. It includes the waste streams which are shown in Figure 4.

Figure 4. *Key waste streams in the construction sector*

Other relevant waste streams in the construction sector include paper, plastics, glass and hazardous waste, such as asbestos.

Snapshot of current practices

Construction and demolition waste can have significant impacts on landfill airspace[i] due to the large volumes and weights of the waste being disposed, resulting in higher transport and tipping fees. The high cost of formal waste disposal for construction material often leads to construction and demolition waste being illegally dumped along roadsides and on vacant land.

In Tanzania for example, the tipping fee for construction waste is ten times higher than the tipping fee for general municipal solid waste.

i The volume of space on a landfill site permitted for the disposal of municipal solid waste.

Although impacts to landfill can be significant, most policy and legislative frameworks in emerging markets do not currently address the construction sector specifically, except when addressing hazardous waste. India is, however, an exception in that it recently passed the Construction and Demolition Waste Management Rules 2016[14] that exclusively govern waste management processes, monitoring and reporting requirements in the sector.

Many construction companies are able to achieve high waste recovery rates due to both their own in-house capacity (technology and infrastructure), often resulting in onsite reuse (eg demolition waste being reused as foundations), and the ability to sell some waste stream materials (eg metal, timber, aggregates) to third parties.

The way forward

The construction sector benefits from high reuse and recycling potential, based on the high volumes of aggregates and value of metal and wood waste produced. Aggregate waste can normally be fed back in as a raw input, while metal and wood waste can usually be easily sold through informal recycling networks.

There is significant potential for construction and demolition businesses to reduce or entirely eliminate the demand for third-party waste services and their associated costs by employing in-house resources to reuse and recycle their waste.

Two notable guidelines on waste solutions in the construction sector are outlined in the box.

Reducing construction and demolition waste

- The EU Construction and Demolition Waste Management Protocol: this provides a set of guidelines, laws and key considerations for producers of demolition and construction waste.
- The Indian Construction and Demolition Waste Management Rules, 2016: these provide useful guidance and are written to suit the less formal and advanced context of waste management operations and technologies available in emerging markets, where the role of the informal sector and informal construction operations are integral.

Sorting

Non-inert materials and products (eg timber) need to be sorted by their economic value. Metal, which is an inert waste,[j] has an established resale value, and there is significant demand for materials such as bricks and tiles. Hazardous waste should not be mixed with non-hazardous waste. Some types of construction waste are not hazardous in their original form, but during the demolition stage can become hazardous through mixing, processing or disposal. They can also pollute non-hazardous materials and thus make them non-reusable or recyclable. A classic example is lead-based paint thrown onto a pile of bricks and concrete, turning the whole pile into hazardous waste.[15]

Reuse and recycling

Sound planning of construction activities and related waste management activities on construction sites are prerequisites for high recycling rates and high-quality recycling materials. Much construction and demolition waste is recycled for economic reasons, but recycling materials such as concrete, wood, glass, gypsum drywall and asphalt shingles have benefits beyond financial ones including reducing use of primary materials and landfill space. Table 2 outlines common uses for construction and demolition waste.[14]

Table 2. *Common uses for construction and demolition waste*

Waste stream	Potential uses
Processed aggregates	The use of recycled aggregates is particularly promising as 75% of concrete is made of aggregates. Demolished concrete can be recycled as aggregate and reused, but this depends on the specification of concrete needed and this may be more challenging where the production of high-grade concrete is required.
	If deconstructed properly, bricks can be reused after removal of mortar. Broken bricks can be used for refilling or for manufacturing debris paver blocks or debris blocks.
Wood	Whole timber arising from construction and demolition works can be used easily and directly for other construction projects after cleaning, de-nailing and sizing (noting that the labour costs for undertaking this need to be considered).
Metals	Ferrous metals are the most profitable and recyclable material. Scrap steel is almost totally recyclable and can be repeatedly recycled. Structural steel can also be reused.
	The main non-ferrous metals collected from construction and demolition sites that can be recycled and are of value are aluminium, copper, lead and zinc.
Natural aggregates	Stone can be reused for plinth formation, masonry construction, landscape purposes, ledges, platforms, window sills, coping depending on the form of available stones.
	Spoil, under certain circumstances, can also be safely reused for land reclamation, backfilling and other onsite construction needs.[k]

j Inert waste is neither chemically nor biologically reactive and will not decompose.
k Companies should follow guidance to determine whether the spoil type they have produced is safe for reuse and what actions they may need to take to safely reintroduce spoil waste. Where spoil waste is reintroduced into the surrounding environment, it is recommended to mix the spoil waste with geotextiles to mitigate the risks of trapped solar heat (eg combustion risks) and acid rock drainage (eg water pollution). Spoil waste that is left untreated/non-mixed is highly prone to erosion and poses environmental risks.

Energy recovery

Companies can also consider opportunities for energy recovery through the use of refuse-derived fuel (RDF), which offer substitute fuel alternatives. Contaminated wood and wood-based products that are not suitable for reuse or recycling, non-recyclable plastics, organic insulation, bitumen and corrugated materials are examples of waste streams that can all be converted into RDF.

Several technologies have been developed for the processing of construction and demolition waste for refuse-derived fuel sorting and production.[16] In some countries (such as Pakistan) there are guidelines for processing and using these in the cement industry. The Cement Sustainability Initiative also includes industry guidelines for their use.[17]

Lafarge Cement, Kenya

Lafarge Cement Plant in Mombasa has successfully implemented using waste outputs as supply inputs (eg using an aggregate crusher) as well as incinerating wood and plastic waste for heat generation.

Manufacturing

Key waste streams

The manufacturing sector includes a variety of business types and production activities that result in a range of different waste streams. Generally, non-hazardous waste consists of mixed plastic, glass, paper and metals while hazardous components often contain chemical or heavy metals (eg mercury).

This section focuses on mixed plastics and e-waste (eg discarded electronic devices), given the high volumes generated and the intrinsic challenges in managing them. E-waste is the fastest-growing waste stream globally with an annual growth rate of 3 to 4%, as a result of increased consumer demand, and perceived and built-in obsolescence due to rapid development in technology and new electronic devices. It includes the categories presented in Figure 5.

Figure 5. *Categories of plastic and e-waste*

Snapshot of current practices

Recycling and recovery rates are generally low in the manufacturing sector, even when considering the role of partnerships that may exist between manufacturing firms and waste management operators in the informal sector. The most notable waste management initiatives typically originate from large manufacturers with international partnerships or influence (eg ISO considerations, stricter due diligence from international funders), and in countries with relevant legislation.

Plastics

Mixed plastics,[l] also produced by commercial entities, are often managed as part of the municipal waste stream. Of the 8.3 billion metric tonnes of plastic produced globally since the 1950s, 6.3 billion metric tonnes are plastic waste. Of that, only 9% has been recycled. The vast majority is accumulating in landfills or in the natural environment, particularly in emerging markets.[18] This is because the economic value of recycled plastic is sometimes immaterial or not fully recognised, and regulations on plastic waste do not exist or are weakly enforced. However regulations are becoming increasingly stringent globally. An example of this new trend is Kenya's recent ban on plastic bags, which is being strongly enforced.

E-waste

Emerging markets often lack the legislation, standards and infrastructure needed to manage e-waste effectively. Informal collection practices, followed by unsafe recovery and recycling methods, are common and can cause severe damage to the environment and human health.

Substandard treatment techniques include open burning to extract metals, acid leaching for precious metals, unprotected melting of plastics, and direct dumping of hazardous residuals. Globally, only 20% of the collection and recycling of e-waste generated is documented and these rates reduce to 0% in Africa.[19] This is likely to mean that substandard treatment techniques are adopted for the remaining e-waste.

In India e-waste generation stood at 1.7 million metric tonnes in 2014 and is increasing at a rate of 30% per annum. While 38% of the total e-waste produced was available for recycling, in 2007 only 5% of the e-waste generated was recycled. In emerging markets, it is also mainly the informal sector that recovers valuable materials from e-waste but often uses rudimentary and inefficient recycling practices, creating a significant impact on public health and the environment. In 2013 up to 90% of e-waste produced in Bangalore was managed through the informal sector despite the Karnataka State Pollution Control Board's efforts to set up a formal recycling system.[20]

l There are seven types of mixed plastics: polyethylene terephthalate (PET), high-density polyethylene (HDPE), polyvinyl chloride (PVC), low-density polyethylene (LDPE), polypropylene (PP), polystyrene (PS) and other types of plastic. For examples, please see http://www.wrap.org.uk/content/types-plastic

The way forward

Product-stewardship programmes are growing around the world and in emerging markets including those for electronic waste in China,[21] plastic packaging in Tunisia[22] and PET in India.[23] Some of these schemes are industry owned, indicating the opportunity for the private sector, while others are run by third-party organisations.

> "We've been able to turn an initial investment of US$1.2 million in a tyre re-treading plant into both a sustainable waste recovery practice and a new income generating activity, now representing 3% of our revenue stream. The investment is expected to pay itself off by 2025."
>
> **James Magor – Actis for AutoXpress (Kenya branch)**

Plastics

The light-manufacturing sector has high reuse and recycling potential. But investments may be needed to bring recycling activities in-house or to form strategic partnerships with recycling entities in the formal or informal sector.

Opportunities for reducing volumes of waste plastic include replacing less durable plastics such as PET with PP and HDPE, which offer greater durability and higher recyclability, or with other materials like glass. Plastics can also be reused to produce arts and crafts, for example by distributing them among employees, even though volumes might not be significant.

Recycling options range from simple to more complex technologies. Baling and crushing are simple processing technologies that increase plastic value. The average cost for operating a baler is US$10–12 per metric tonne of plastic processed. Baled PET plastic can be sold at 50% more than its value when unprocessed.

The cost of operating semi-advanced recycling technology, such as pelletising or moulding for example, is US$7–15 per metric tonne, but the price of pelletised (produced after the extrusion process) HDPE can reach 500% more than the price of unprocessed HDPE. Table 3 gives estimates of average selling prices, as of 2017, for different types of plastic that have undergone various degrees of recycling processes.

Table 3. Estimates for sale price for different types of plastic, 2017

Global market pricing – plastics (2017) US$			
Waste type	**Processing level**	**Price (low)**	**Price (high)**
PET	Unprocessed	250	400
PET	Baled	450	550
PET	Flakes	600	800
PET	Granules/pellets	900	1200
HDPE	Unprocessed	240	260
HDPE	Regrind/flakes	800	840
HDPE	Pellets	920	980
PP	Unprocessed	260	280
PP	Regrind/flakes	840	920
PP	Pellets	960	1050
LDPE film	Baled	480	600
LDPE film	Pellets	1280	1520

E-waste

E-waste includes precious metals such as gold, silver, platinum and palladium that make their recovery from e-waste a lucrative proposition. For example, 183 computers bought for US$9 each are equivalent to 5 tonnes of e-waste. The value of extractable material from these 183 computers is US$4,232, which amounts to a profit of US$2,619 equivalent to 1.6 times the material cost.

Opportunities to reduce and reuse e-waste start with good maintenance of equipment and include replacing electronic devices with more long-lasting ones (eg LED light bulbs) or rechargeable ones (eg rechargeable batteries). Take-back schemes, often linked to appropriate recycling facilities, also lead to an increase in the recycling rates.

India introduced the concept of 'Extended Producer Responsibility' (EPR) in 2011. This was aimed at the effective management of e-waste, as well as action by stakeholders including producers, manufacturers and retailers to establish an operationally and economically viable e-waste management ecosystem. However this did not lead to effective implementation by producers, and in 2016 revised e-waste management legislation was introduced to strengthen the EPR framework. This included development of take-back programmes and e-waste exchanges.

E-waste collection centres, India

Dell has 16 e-waste collection centres based alongside their service centres across 13 cities in India.
In 2012, Dell launched a free battery-recycling programme, whereby customers returning batteries were given a 500-rupees discount on another Dell battery.
It also launched a laptop discount programme that allowed customers to receive a 1,000-rupees coupon to buy a new Dell computer if they sent in their old computers for free recycling. In the 2013 financial year, Dell recycled over 77,000 metric tonnes of electronics globally.

Some African countries such as Tanzania, Rwanda and Kenya have put increased focus on e-waste in recent years and the number of recycling initiatives has increased. Most of these recycling centres first repair and refurbish the e-waste, if possible. If repairing is not feasible, the e-waste components are dismantled and separated. Some components are then sold directly as parts or materials; others are subject to basic recycling treatments; and others, which are more complex to recycle (such as lamps containing mercury or CRT (cathode ray tube) monitors containing lead), are exported for appropriate treatment and disposal.

Off-grid solar e-waste management in East Africa: Defining challenges and identifying solutions

M-Kopa (a CDC investee), CDC and GOGLA organised a workshop in Nairobi, Kenya in 2018, to bring together industry leaders, recyclers and investors to discuss the status, challenges and opportunities linked with e-waste management for the off-grid solar sector. The workshop aimed to identify tangible projects and partnerships to move the sector forward.

While this topic has long been on the agenda, this was the first workshop of its kind in Africa. The industry has made great strides to develop the off-grid solar market and in doing so is delivering huge impact to off-grid customers, mitigating greenhouse gas emissions from traditional polluting lighting sources and supporting economic development in low-income countries.

Wider action on e-waste management in CDC's geographies has been held back by a concern that any additional costs incurred would have to be passed on to customers, reducing product affordability and hurting market growth. The challenge is compounded by inadequate recycling infrastructure in the main off-grid solar markets. Despite this, leading companies – such as M-Kopa, Mobisol and Off-Grid Electric – have established e-waste management operations and partnerships.

Some next steps discussed and agreed at the workshop include:

- developing an e-waste toolkit to guide off-grid solar companies in best practice at each step in the product life cycle;
- identifying product design features to enhance repairability and recyclability;
- developing customer-facing information to raise awareness on environmentally sound waste disposal options;
- assessing practicable and implementable extended producer responsibility schemes;
- increasing engagement with the policy and regulatory authorities to help inform potential future regulatory requirements; and
- determining the business case to support existing e-waste management companies, or new opportunities to effectively manage all the e-waste produced in the region.

Conclusions

Solid waste that is unsustainably managed poses considerable risks for public health, water, land and air contamination, which in turn can significantly affect agricultural yields and natural resources that many emerging markets rely on. Waste management is also often associated with risks around use of child labour and occupational health and safety issues that are particularly widespread in the informal sector, as well as criminal activities. Equally there are clear opportunities to be realised, and the extractable value from waste flows is often higher than perceived or than recovery rates suggest.

The focus on improved waste management is also increasing due to explicit reference to waste management as a key way to reduce the environmental impact of cities in the Sustainable Development Goals (target 11.6).[13] There is also an evident shift in legislation across several countries with requirements becoming more and more stringent (in Kenya, Rwanda and India for example).

This research shows that sustainable solutions need to be found locally and regionally, particularly for hazardous waste, as the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal limits opportunity for international service providers to offer environmental solutions for managing hazardous wastes.

Across the sectors examined, sustainable interventions broadly fall into three categories:

Onsite solutions

There are often opportunities for companies to develop onsite solutions. This is particularly relevant where there are no formalised systems and where waste volumes are sufficiently large, noting that any solutions identified will need supporting feasibility assessments.

Aggregation

A key way to address waste management challenges in emerging markets may be through aggregation and by achieving economies of scale. The ability to segregate and aggregate waste flows into meaningful volumes can help build a case for investing in technology and infrastructure capable of extracting more value, stimulating the development of businesses and encouraging supply chains to professionally organise.[2] There are also opportunities for private sector actors to leverage existing networks and develop partnerships that enable economies of scale and aggregation to be achieved.

Third-party services

There are third-party markets for reselling and processing recovered waste in most sectors but these are often difficult to locate and track because of their informal nature. Identifying these markets is often not a priority for business owners but can bring significant benefits if acted on.

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m Target 11.6: "By 2030, reduce the adverse per capita environmental impact of cities, including by paying special attention to air quality, municipal and other waste management."

References

1 Lardinois, I. and van de Klundert, A. 1995. *Community and private (formal and informal) sector involvement in municipal solid waste management in developing countries*, Ittingen Workshop, Switzerland, 12 April 1995. Available at: www.gdrc.org/uem/waste/swm-finge1.htm

2 Engel, H et al. 2016. *Managing waste in emerging markets*. Available at: www.mckinsey.com/business-functions/sustainability-and-resource-productivity/our-insights/managing-waste-in-emerging-markets

3 Hoornweg, D. and Bhada-Tata, P. 2012. *What a waste – Global review of solid waste management*. Available at: https://siteresources.worldbank.org/INTURBANDEVELOPMENT/Resources/336387-1334852610766/What_a_Waste2012_Final.pdf

4 Chartier, Y et al. 2014. *Safe Management of Wastes from Health-care Activities*. Second Edition, Geneva: WHO. Available at: https://noharm-global.org/articles/news/global/new-who-handbookhealthcare-waste-management

5 PwC. 2012. *Healthcare Infrastructure and Services Financing in India: Operation and Challenges*. Available at: www.pwc.in/assets/pdfs/publications-2012/healthcare_financing_report_print.pdf

6 Manasi, S. 2017. *Challenges in Biomedical Waste Management in Cities: A Ward Level Study of Bangalore*. OMICS International.

7 Pruss-Ustun, A. et al. 2005. E*stimation of the global burden of disease attributable to contaminated sharps injuries among health-care workers*. Available at: www.who.int/quantifying_ehimpacts/global/7sharps.pdf

8 WHO. Undated. *Managing healthcare waste – the Bir hospital experience*. Available at: www.searo.who.int/entity/water_sanitation/bir-hosp-booklet.pdf?ua=1

9 Di Bella, V. 2016. *Healthcare Waste Management in Developing Countries*. Available at: https://answers.practicalaction.org/our-resources/item/health-care-waste-management-in-developing-countries edited

10 www.fao.org/fileadmin/user_upload/obsolete_pesticides/docs/small_qties.pdf

11 Tilley, E et al. 2014. *Compendium of Sanitation Systems and Technologies*. 2nd revised edition. Swiss Federal Institute of Aquatic Science and technology (Eawag). Dubendof, Switzerland. Available at: www.iwa-network.org/wp-content/uploads/2016/06/Compendium-Sanitation-Systems-and-Technologies.pdf

12 Hait, J. 2014. A pest management toolbox to reduce pesticide use. Available at: https://phys.org/news/2014-04-pest-toolbox-pesticide.html#jCp

13 AgroChePack. Undated. *Guidelines for Triple Rinsing Small Agrochemical Containers*. Available at: www.agrochepack.aua.gr/DELIVERABLES/guidelines/AGROCHEPACK_GUIDELINES_3%20RINSING_EN.pdf

14 Indian Central Pollution Board, 2016. *Environmental Management of Construction and Demolition Wastes*.

15 Ecorys. 2016. *EU Construction & Demolition Waste Management Protocol*. Available at: http://ec.europa.eu/environment/waste/construction_demolition.htm

16 Magsep, 2018. http://www.mssoptical.com/

17 World Business Council for Sustainable Development (WBSD). 2014. *The Cement Industry – Creating solutions for safe resource-efficient waste management*. Available at: www.wbcsdcement.org/pdf/Waste%20management%20solutions%20by%20the%20cement%20industry.pdf

18 National Geographic. 2017. *A Whopping 91% of Plastic Isn't Recycled*. Available at: https://news.nationalgeographic.com/2017/07/plastic-produced-recycling-waste-ocean-trash-debris-environment/

19 Balde, C.P. et al. 2017. *The Global E-waste Monitor 2017, Quantities, Flows and Resources*. Available at www.itu.int/en/ITU-D/Climate-Change/Pages/Global-E-waste-Monitor-2017.aspx

20 Borromeo, L. 2013. *India's e-waste burden*. Available at: www.theguardian.com/sustainable-business/india-it-electronic-waste

21 Institute for Sustainable Futures. 2009. *Product stewardship schemes in Asia: China, South Korea, Japan and Taiwan*. Available at: www.environment.gov.au/protection/national-waste-policy/publications/product-stewardship-schemes-asia-china-south-korea-japan-and-taiwan

22 Sweepnet. 2014. *Report on the solid waste management in Tunisia - Chapter 6*. Available at: www.retech-germany.net/fileadmin/retech/05_mediathek/laenderinformationen/Tunesien_laenderprofile_sweep_net.pdf

23 Dickinson, K. 2018. *Unilever trials circular technique for PET plastic recycling*. Available at: https://resource.co/article/unilever-trials-circular-technique-pet-plastic-recycling-12496

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