

Longer Term Investments

Waste management and recycling

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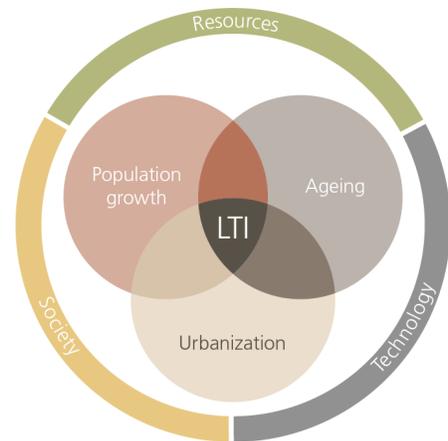
- Several megatrends fuel the demand for efficient waste management. They include population growth, rising living standards, public health, industrialization and urbanization in emerging markets, and the tendency toward shorter product life cycles of electronic devices.
- By 2050, 3bn people will belong to the middle class. Their disposable income will suffice to purchase products in a way comparable to people in high-income countries today. In 2012, the world's cities produced 1.3bn tons of waste; by 2025, the World Bank estimates waste to be 2.2bn tons.
- While collection rates in high-income cities have risen to 100%, the average in low-income cities is only 35%. The UN estimates that at least 2bn people have no access to solid waste collection. In particular, the poor in urban areas are severely affected by unsustainable waste management.
- The low treatment rates in emerging markets offer big catch-up potential that could lead to extraordinary growth rates. In general, tighter regulation and an emphasis on "greening" the waste sector (according to the "4R's" – recover, recycle, reuse, and reduce) should lead to greater capital expenditures that benefit a broad range of companies.

Our view

Today, the waste sector has a market size of more than USD 1.5tr a year. We forecast it to grow at a high-single-digit rate for the next several years and, by 2020, to become a USD 2tr market. In general, the higher a nation's income level and urbanization rate are, the greater the amount of solid waste it produces. The Intergovernmental Panel on Climate Change estimates that solid waste accounted for 3% of global greenhouse gas emissions in 2010, mainly due to methane emissions from landfills. Proper waste management can greatly reduce such emissions. An efficient waste management infrastructure is also commercially important, particularly in emerging markets where it often takes up 20–50% of municipal budgets. This topic is also included directly and indirectly in several UN Sustainable Development Goals. The theme covers different waste subsectors that can include businesses ranging from strong growth companies in emerging markets, to pure-play recycling companies with a more cyclical business model, to large waste companies in the US with stable and solid cash flows.

Introduction to the Longer Term Investments (LTI) series

- **The Longer Term Investments (LTI)** series contains thematic investment ideas based on long term structural developments.
- Secular trends such as population growth, ageing, and increased urbanization create a variety of longer term investment opportunities.
- These investment opportunities are influenced by the interplay of technological advancement, resource scarcity, and the societal changes.
- Investors willing to invest over multiple business cycles can benefit from potential mispricings created by the typically shorter term focus of stock markets.



Introduction

In the following sections, we describe the factors that support this investment theme, discuss in more detail important parts of the waste management value chain, and conclude our analysis with a section about investment opportunities and risks.

Waste volumes are expected to double in the coming decades

In 2012, the World Bank estimated that the waste generated per person per day was roughly 1.2kg, compared to 0.64kg only 10 years before. By 2025, it estimates waste to be 1.42kg per person per day. At the same time, the urban population will rise from 3bn today to 4.3bn in 2025, nearly doubling waste volumes. The International Solid Waste Association expects a similar scenario. Based on its forecasts, using 2006 as a base year, municipal solid waste volumes will rise by a factor of 2.37x by 2050.

Daniel Hoornweg, one of the authors of the World Bank report "What a Waste" that we cite in this report, estimates that the pinnacle of waste volumes will not occur in this century. He expects OECD countries to peak in 2050 and Asia Pacific in 2075, but waste will continue to rise in the fast-growing urban areas in sub-Saharan Africa.

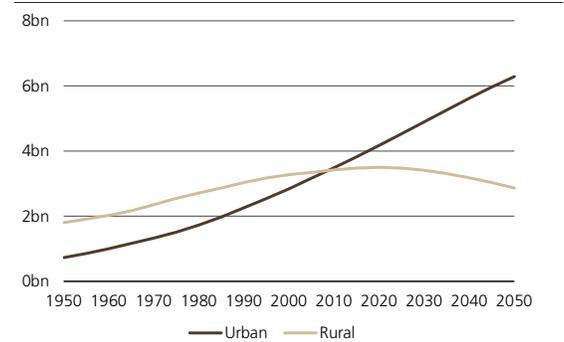
The lack of consistent data from emerging markets makes it hard to give a precise market size of the global waste management sector. Using information from several research sources, we estimate it was slightly more than USD 1.5tr last year. Low recovery and recycling rates (only 25–30%) on one hand, and high landfill rates (roughly 70%) on the other, make for an interesting investment opportunity for the coming decades. Higher value-added treatment and better waste collection rates should increase industry size. By 2020, we expect the market to grow to around USD 2tr.

Key drivers: Urbanization...

A main factor behind waste industry growth is the urbanization trend. In 1950, only 29% of the world's population lived in urban areas (see Fig. 1). By 2008, the global urban population had already exceeded the rural population. The UN expects this trend to continue, with 70% of Earth's population residing in cities or urban settings by 2050. While the inhabitants of most developed countries have been concentrated in urban areas since the mid-20th century, emerging nations still have catch-up potential.

In the 1970s, the world had only three megacities, all located in the northern hemisphere (two in Japan and one in the US). In the 1990s, the number rose to 10, with half found in the southern hemisphere. By 2030, the UN expects megacities to number 40, of which 32 will lie south of the equator. Already today, more than three-quarters of cities with over 1mn inhabitants are found in Asia, Latin America, and Africa. Since waste generation is much higher in cities than in rural areas, urbanization should lead to higher waste volumes. Urban residents also produce more inorganic waste (e.g. plastics and aluminum). Growing waste volumes will thus become a major emerging market (EM) challenge, given the projections of robust population growth until mid-century in Asia and until the end of the century in Africa (see Fig. 2).

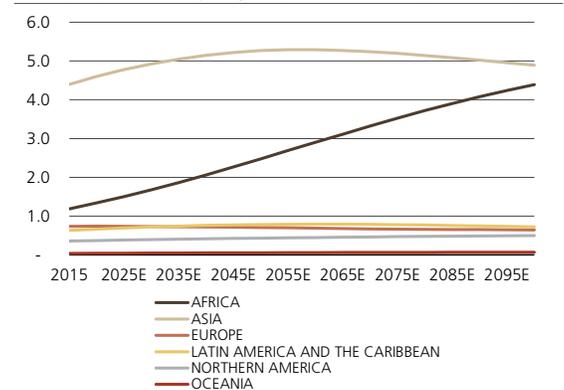
Fig. 1: Urban and rural populations
1950–2050E



Source: UN, Population Division – World Population Prospects, the 2012 & 2014 Revisions; E= estimate

Fig. 2: Strong EM population growth, particularly in Africa

Total population by region, 2015–2100 (in billion)



Source: UN (2015). Probabilistic Population Projections based on the World Population Prospects: The 2015 Revision. Population Division, UNDESA. <http://esa.un.org/unpd/ppp/>

They will also provide compelling investment opportunities in the area of waste management, with emerging markets offering the biggest opportunity, in our view.

...and GDP growth

Another important factor is growing EM wealth, which translates into higher waste generation. Data analysis based on historical trends shows that the growth rate of municipal solid waste (MSW) is particularly marked for countries whose GDP ranges between USD 5,000–10,000 per capita. This trend was evident in the US. According to the US Environmental Protection Agency, from the 1960s through the 1980s, when US per capita GDP rose from USD 3,000 to USD 23,000, waste volume per person rose from 1.3kg per day to 1.8kg (see Fig. 3). In the 2000s, it reached 2.2kg and has declined slightly since (2kg in 2014).

While in the per-capita GDP range of USD 5,000–10,000, US residents produced 0.13kg per person per day more waste for every USD 1,000 of increased GDP. Once the USD 10,000–20,000 range was reached, growth slowed to only 0.03kg per person per day for every USD 1,000 rise in GDP. Several emerging markets are now in the USD 5,000–10,000 per capita zone (e.g. Brazil, Bulgaria, China, Malaysia, Romania, Russia, South Africa, Thailand, based on World Bank data) or will be moving into it soon, putting them under enormous pressure to invest in the MSW sector.

Waste categories and types

Municipal solid waste

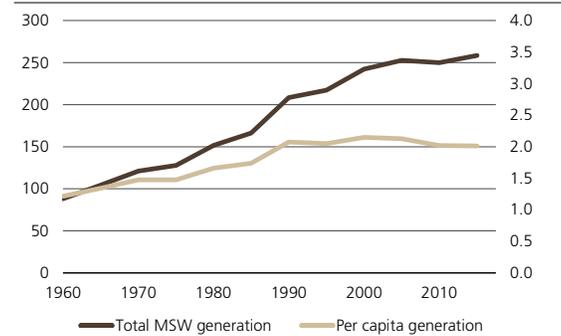
MSW is more commonly known as the trash or garbage discarded daily by the public. After the US and China, the world's largest waste producers are Brazil and Japan (see Fig. 4). In 2010, the high-income countries generated 50% of global MSW, but this will change soon. By 2030, Asia will overtake the above countries, and the UN expects that later in the century Africa could surpass Asia. Landfilling of waste is still the most common method of MSW disposal in richer countries, and in low-income countries disposal often occurs in open dumps (see global overview in Fig. 5). In the rural areas of low-income countries, 0% controlled disposal is still relatively common.

Emerging markets are most attractive from a growth perspective due to the ongoing urbanization trend, rising GDP, and low penetration rates. While most developed countries have high waste collection ratios (see Fig. 6), many emerging markets still lag.

Urban areas in China provide a good example of how this challenge has been met in the last 10 years. Its waste treatment ratio was only 53% in 2006, but it rose to 97% in 2016 (see Fig. 7). The combination of continued waste volume growth and catch-up potential due to low incineration penetration should lead to several years of high annual growth rates for China's waste operators.

Fig. 3: US municipal solid waste (MSW) generation rates 1960–2014

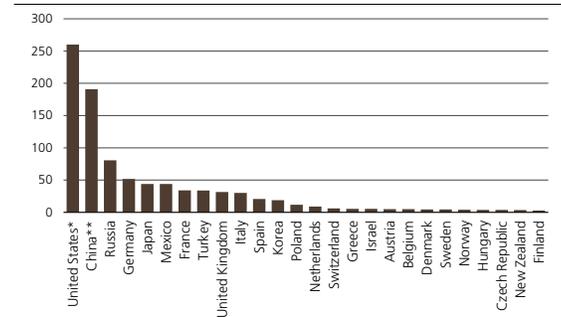
Total waste in million tons (lhs), per capita in kg per day (rhs)



Note: lhs = left hand side; rhs = right hand side Source: US EPA as of November 2016

Fig. 4: MSW generation by country

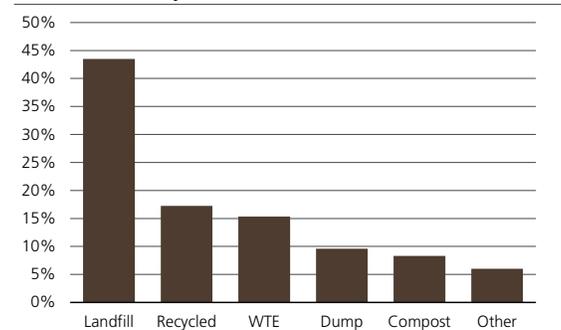
MSW breakdown 2015/16E (in million tons)



Source: OECD Stat as of May 2017, * US data = US EPA (2014), ** China data = National Bureau of Statistics (2016), UBS adjustments

Fig. 5: Total MSW disposed of worldwide

In millions tons/year



Note: WTE= Waste-to-Energy Source: The World Bank (WHAT A WASTE: A Global Review of Solid Waste Management), as of June 2012

For the Chinese government, waste treatment is high on its agenda. China wants to achieve 100% treatment for the capital cities of provinces, 90% for all cities, and 70% for all counties. As a result, the capacity build-out needs to markedly exceed the underlying waste volume growth of roughly 3% annually by 2020.

In addition to China, Brazil, India, and Mexico are among the countries that should experience marked waste volume growth. As is the case in China, urbanization and rising incomes in these countries, producing a change in lifestyles, will contribute to waste generation and should lead to major investment. We think emerging markets offer significant opportunities in waste management for companies able to take advantage of them.

Recycling

Recycling is an important topic in the waste management theme, as it is one of the most sustainable ways to handle waste. In general, a higher GDP also corresponds with higher recycling ratios. More than 80% of additional waste generation in richer countries is fueled by recyclable material like glass, metals, paper, and plastics.

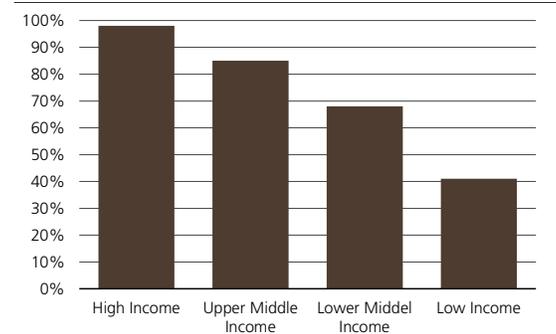
This correlation is also apparent when comparing recycling ratios between emerging and developed countries. Based on University of Leeds (Wasteaware as of May 2014) calculations, recycling rates hit 60–80% in cities like San Francisco (US) and Antwerp (Belgium), but only 20–40% in Varna (Bulgaria) and Athens (Greece), and a mere 0–20% in cities like Maputo (Mozambique) and Lusaka (Zambia). There are exceptions in lower-income countries, such as Surat, an Indian city with more than 2mn people. The recycling rate there is near 50%.

Looking at recycling rates in Europe and the US (see Figs. 8 and 9), we find that Western Europe is leading due to strict regulation, and many Eastern European countries are lagging. We expect that the EU will put pressure on Eastern European governments to improve recycling rates. In the US, landfill regulation is established and does not change often. Since President Donald Trump has shown not to be in support of subsidies or tax credits, companies and individuals may have fewer incentives to recycle, potentially resulting in more volume at the landfill.

In some emerging markets, the ratio is relatively high due to the inadequacy of public collection infrastructure, and people sell paper and metal to individual waste collectors to generate additional income. Paper is, of course, only one part of the recycling universe; recycling of electronic waste and plastic packaging is less developed. The recycling industry has been among the waste subsectors with the highest growth rates in recent years.

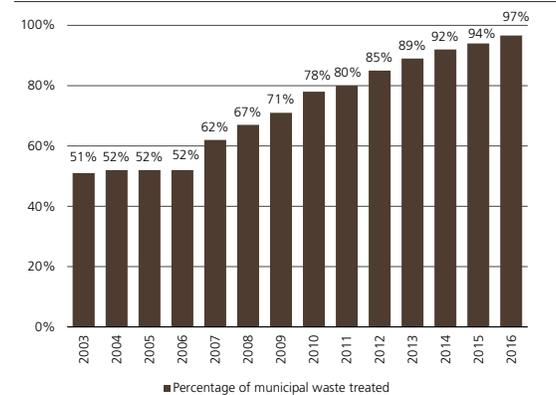
The profit-and-loss statement of Umicore, a global company engaged in metals recovery and refining, demonstrates that margins and volumes depend highly on commodity prices and industrial output. Based on UBS estimates, the revenue growth of Umicore's recycling business has had an 80%-plus correlation to a weighted basket of precious and base metals prices over the past 10 years. The higher (or lower) metal prices are, the better (or worse) it is for recycling companies. Rising metal prices in recent years have increased their rev-

Fig. 6: Waste collection rates relative to income
Waste collection in %



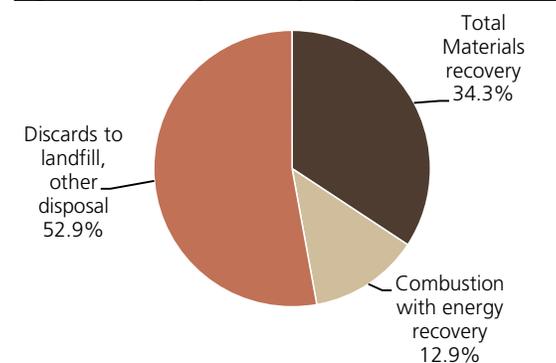
Source: The World Bank (WHAT A WASTE: A Global Review of Solid Waste Management), as of June 2012

Fig. 7: Percentage of municipal waste treated in China



Source: Ministry of Housing and Urban-Rural Development, UBS as of March 2018

Fig. 8: Percentage of recycling in the US



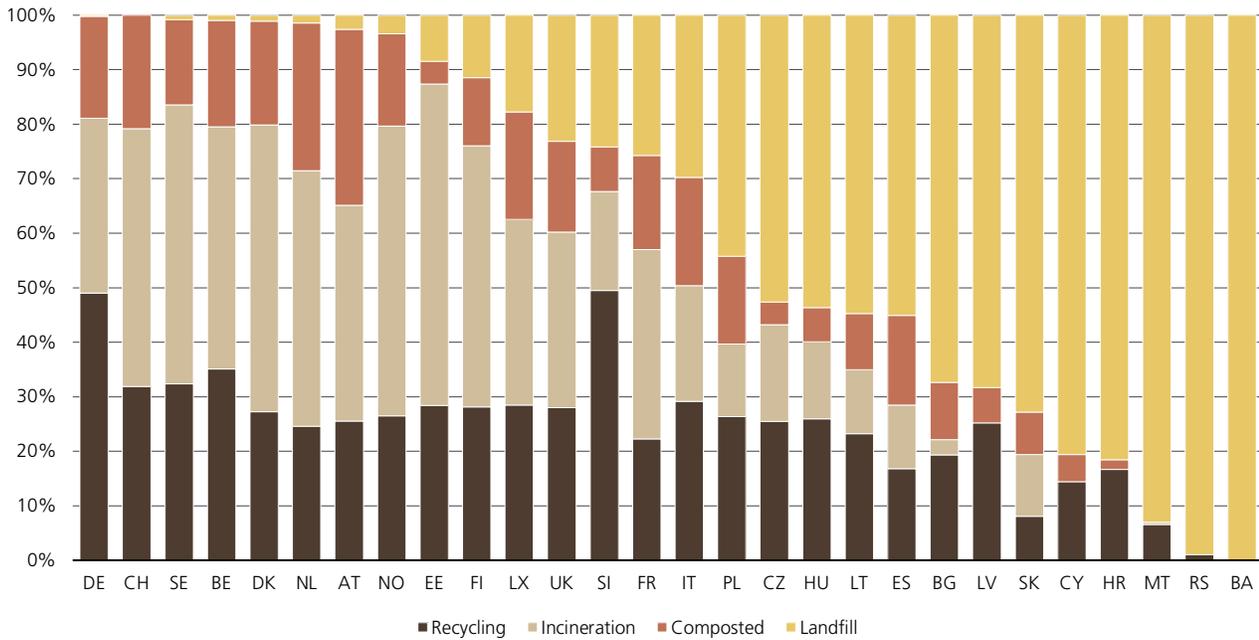
Source: EPA, 2014 data

enues and margins. Hence, the recycling industry is the most cyclical part of the waste management value chain.

Industrial waste

The industrial waste sector comprises several end-markets, including manufacturing, chemical, textile, and construction. The greatest growth in waste volumes is in the emerging markets (due to the catch-up effect), though developed markets have also exhibited solid rates of expansion due to stricter regulation and recycling requirements.

Fig. 9: Strong divergence in recycling rates between Eastern and Western Europe



Source: Eurostat (as of May 2017), UBS Note: BA = Bosnia and Herzegovina, RS = Serbia, MT = Malta, HR = Croatia, CY = Cyprus, SK = Slovakia, LV = Latvia, BG = Bulgaria, ES = Spain, LT = Lithuania, HU = Hungary, CZ = Czech Republic, PL = Poland, IT = Italy, FR = France, SI = Slovenia, UK = United Kingdom, LX = Luxembourg, FI = Finland, EE = Estonia, NO = Norway, AT = Austria, NL = Netherlands, DK = Denmark, BE = Belgium, SE = Sweden, CH = Switzerland, DE = Germany

The industrial waste sector also includes wastewater and hazardous-waste end-markets. In this report, we mention the wastewater market only in passing; we discuss this market in greater detail in our "Water scarcity" report published 20 February 2018. In emerging markets, the treatment of industrial wastewater is already fairly advanced. In China, for example, more than 70% of industrial water is treated. Wastewater has been a key focus in recent years, its treatment supported by rising tariffs. Also, the treatment of hazardous waste has improved; in 2016, according to the National Bureau of Statistics, China responsibly disposed of more than 80% of its hazardous waste.

Changing regulations should increase treatment volumes. Since January 2013, illegal discharge of hazardous waste has been a criminal offense in China, which aims to raise volumes of treated hazardous waste by more than 75% over 2010 levels (according to the government's 12th Five-Year Plan). Based on market estimates, the penetration ratio should rise considerably, but capacity will likely still lag demand as the current level is so low.

In developed countries, the EU has focused on waste recycling and recovery. As a result, landfill taxes are rising, making it less attractive to landfill and putting pressure on volumes. In the Americas, the US is by far the largest waste market, followed by Canada and Brazil. The regulation in these countries is less strict than in Europe, but there, too, recycling rates are relatively advanced.

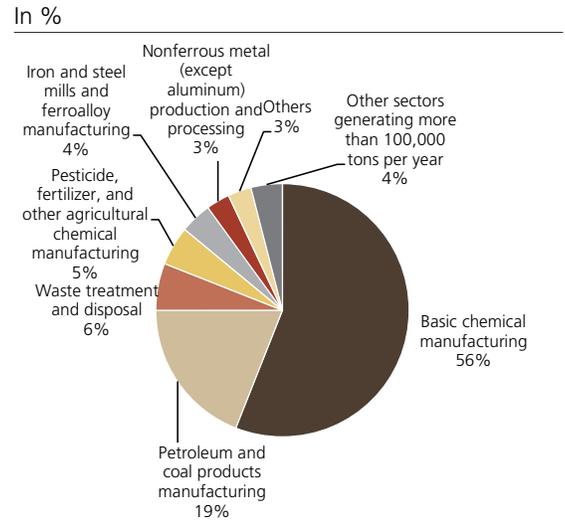
In our view, the hazardous waste segment offers appealing opportunities. Typical examples are chemical, medical, nuclear, and oil and gas waste. Fig. 10 provides an overview of the main hazardous-waste producers by sector in the US. Stricter regulations and a trend toward outsourcing services make the medical waste sector a particularly attractive market.

In the oil and gas sector, drilling in unconventional areas (for shale gas and oil) produces ever more waste. In particular, the massive increase of "produced water," a byproduct of drilling, creates opportunities for waste management. Another interesting end-market is the nuclear sector, which globally produces more than 200,000 cubic meters of low- and intermediate-level radioactive waste and roughly 10,000 cubic meters of high-level waste. To illustrate, an average 1,000MW nuclear power plant generates 200–350 cubic meters of low- and intermediate-level waste per year. In addition to power plants, hospitals and laboratories produce nuclear waste.

E-waste – we live in world of gadgets

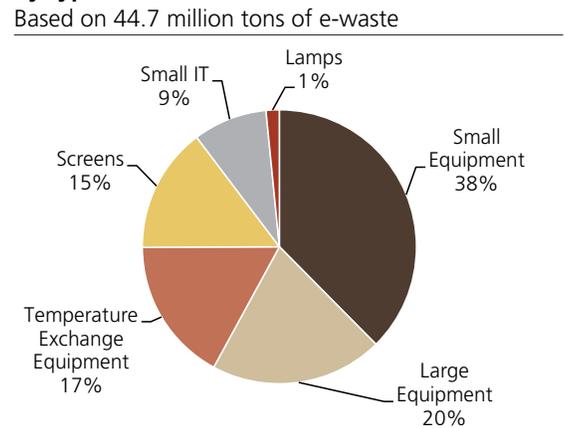
E-waste is one of the fastest-growing waste markets globally. The market was around 44.7 million tons (MT) worldwide in 2016 (see Fig. 11). Asia leads with 18.2MT, followed by Europe with 12.3MT, Americas 11.3MT, Africa 2.2MT and Oceania 0.7MT. On a per-person basis, the ratio looks different, with Europe (16.6kg per person) and Africa taking up the rear (1.9 kg per person). Small electronic devices contribute most of the e-waste, which typically contains 60% metals, including copper and gold, and is considered hazardous; recycling is the only way to treat it.

Fig. 10: Sectors in the US generating the largest quantities of hazardous waste



Source: US EPA. National Analysis – The National Biennial RCRA Hazardous Waste Report (Based on 2011 Data) (<http://www.epa.gov/epawaste/inforesources/data/br11/national11.pdf>).

Fig. 11: Amounts of e-waste generated in 2016, by type



Source: The Global E-waste Monitor 2017 (Quantities, Flows, and Resources) Authored by Baldé, C. P., Forti, V., Gray, V., Kuehr, R., Stegmann, P.; UN University, ISWA

Based on the latest available numbers (2016), only a small part of e-waste is collected and recycled: around 35% in Europe, and 15% to 17% in Asia and the Americas (Source: UN). The rest goes into landfills and incinerators or to waste traders. Tougher regulations and the value of the metals make e-waste a fast-growing market. Volumes are rising at a fast pace and, by 2021, the UN estimates they will reach 52.2MT. On a per-capita basis, e-waste is expected to rise from 6.1kg in 2016 to 6.8kg in 2021. What's problematic is that, according to the Global E-Waste Monitor report, most global e-waste is illegally dumped or traded; it is falsely declared as a second-hand good and exported from developed to developing nations. Only 41 countries worldwide have official e-waste statistics. The amount of valuable metals in a million mobile phones is also impressive: 24kg of gold, 250kg of silver, 9kg of palladium, and more than 9 tons of copper. One ton of e-waste contains more gold than 17 tons of gold ore (Source: UNEP). In general, recycling not only helps to recover metals but saves energy and other resources like water. At the same time, it reduces emissions (see more details in Box 1: Saving resources).

Box 1: Saving resources

Based on IPCC estimates (Intergovernmental Panel on Climate Change), you can reduce greenhouse gas emissions in glass production by 35% using secondary raw material instead of virgin materials. In the case of steel and paper, the savings are over 50%; with plastics over 70%; and with aluminum over 90%.

Source: UN Environmental Program 2015: Global Waste Management Outlook

Global waste market overview

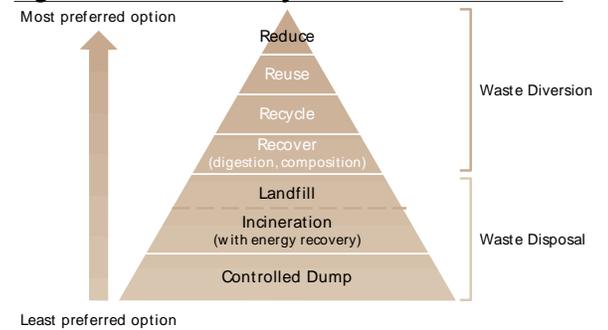
Global waste composition

The composition of waste again depends greatly on the economic development of a country, as well as on its culture, climate, and other factors. Low-income countries have the highest portion of organic waste at around 53%. High-income countries produce a high share of paper (24%), plastics (11%), and other inorganic material, with organic waste's share at only 34% (see Fig. 12, next page).

Waste hierarchy

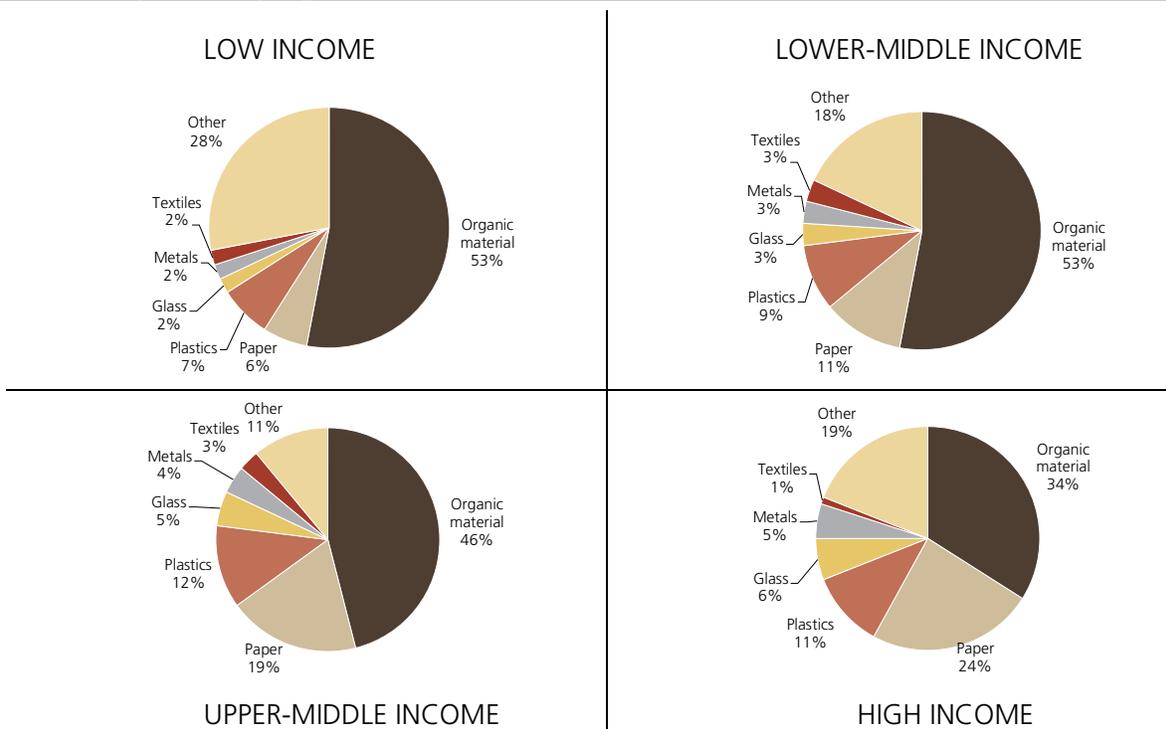
After deciding to treat waste, governments have to select how to do so. The waste sector follows the well-known waste hierarchy (the four R's) first mentioned in the 1970s: recover, recycle, reuse, and reduce (see Fig. 13). The hierarchy encourages minimizing greenhouse gas (GHG) emissions. The most sustainable form of "treatment" is outright waste reduction, though other methods also mitigate environmental damage. They include recycling, aerobic composting, and anaerobic digesting.

Fig. 13: Waste hierarchy



Source: The World Bank (WHAT A WASTE: A Global Review of Solid Waste Management), as of June 2012

Fig. 12: Waste composition by region



Source: United Nations Environmental Program 2015: Global Waste Management Outlook

The cheapest and fastest method is waste disposal, which takes the well-known form of landfills or incineration. In most emerging markets, these traditional methods are well established. In the case of China, landfills dominate. Due to the time pressure to ramp up capacity and a lack of sorting capabilities, we think they will remain the dominant way of treating waste in the near future. The fastest growth is coming from other methods like incineration. From an investment perspective, the incineration market represents the biggest opportunity in China. For the coastal regions in particular, incinerators make sense, as land per capita is limited. Although emissions are questionable with this solution, at least water and soil quality no longer suffers.

Waste management value chain

The waste sector value chain can be broadly split into three parts: upstream, midstream, and downstream. The upstream business involves transport and collection and is generally the part with the lowest margins and highest competition. In the US, we gather that collection services generate EBITDA margins in the 15–20% range, with residential the least volatile, industrial the most, and commercial in between. The midstream part includes treatment, sorting, and recycling. Depending on the region and business model, it is attractive, although it can experience cyclical pressure depending on the waste mix (e.g. industrial waste). Last comes downstream, which includes landfills and incineration facilities. In the US, landfills have EBITDA

margins between 40% and 60%, depending on the volumes and pricing.

Conclusion

The waste investment theme covers different waste subsectors and extends from EM growth companies through pure-play recycling companies with a more cyclical business model to huge public waste companies in the US with stable and solid cash flows. Although other short-term factors can certainly play a key role, we think that our theme will benefit over the medium to longer term from the structural trends outlined in this report. We have a positive view on the waste industry in the US and emerging markets. We think investors must be more selective in Europe. In general, this lower-beta theme benefits from structural trends and fits well in a portfolio for long-term investors.

Risks

The ability of EM governments to pay for municipal waste treatment is a risk, because efficient waste management infrastructure is very expensive. Until now, the low collection rates have meant no additional budget allocation to waste treatment. But this will change. If companies have insufficient information about government spending plans, private firms will stop investing in this sector. Also, lax regulation could lower treatment volumes. In addition, if the global economy falters, local governments in China and elsewhere will focus less on waste and the environment, leading to slower treatment demand growth. In developed countries, the risks are different. Here, companies face the danger of declining waste volumes and waste treatment overcapacity. On a single-stock level, environmental accidents represent the greatest risk.

Appendix

Terms and Abbreviations

Term / Abbreviation	Description / Definition	Term / Abbreviation	Description / Definition
2011E, 2012E, etc.	2011 estimate, 2012 estimate, etc.	A	actual i.e. 2010A
COM	Common shares	CY	Calendar year
E	expected i.e. 2011E	EBITDA	Earnings before interest, taxes, depreciation and amortization
GDP	Gross domestic product	Shares o/s	Shares outstanding
UP	Underperform: The stock is expected to underperform the sector benchmark	CIO	UBS WM Chief Investment Office

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