

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, 3 billion people will belong to the middle class. They will have sufficient disposable income to purchase products in a way comparable to people in high-income countries today. For every US dollar spent globally, about 47 grams of waste is produced. By 2050 waste volumes are expected to more than double.
- While collection rates in high-income cities have risen to 100%, the average in low-income ones is only 35%. The UN estimates that at least 2 billion people have no access to solid waste collection.
- 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.

House view

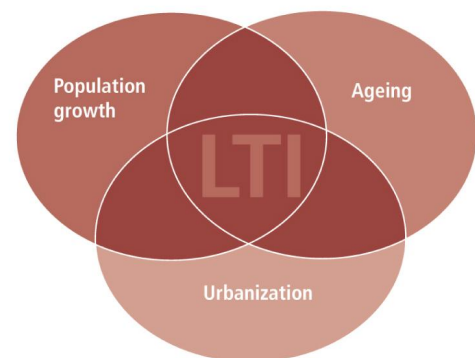
Today, the waste sector has a market size of nearly USD 1.5trn per annum. It is expected to grow at a high-single-digit rate for the next several years and, by 2020, is projected to reach USD 2trn. Along with water scarcity, waste is one of the key challenges that humans face. In 2004, China overtook the US as the world's largest waste generator. The World Bank expects China to produce twice as much municipal solid waste as the US in 2030. In general, you can say that the higher its income level and urbanization rate, the greater the amount of solid waste produced by a country. The Intergovernmental Panel on Climate Change estimates that solid waste accounted for 3% of global Green House Gas emissions in 2010, mainly due to methane emissions from landfills. Proper waste management can greatly reduce such emissions. This topic is also included directly and indirectly in several UN Sustainable Development Goals. The theme covers different waste subsectors, from strong growth companies in emerging markets through pure-play recycling companies with a more cyclical business model to huge waste companies in the US with stable and solid cash flows. Since 2000, the average annual EPS growth of our waste management theme was slightly higher, and less volatile, than the MSCI World index.



Source: iStock

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.
- ▶ 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 estimates are for it to be 1.42kg. 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, municipal solid waste volumes will rise by a factor of 2.37x by 2050 (base year 2006).

Daniel Hoornweg, one of authors of the World Bank report "What a Waste" that we quote in our 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.

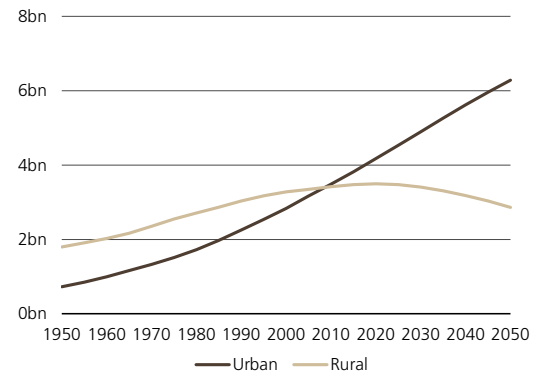
The lack of consistent data from emerging markets makes it hard to give a precise market size of the global waste sector. Using information from several research sources, we estimate it was slightly less than USD 1.5trn last year. Low recovery and recycling rates (only 25-30%), on the one hand, and high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

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. 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 (see Fig. 1). 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 only had 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 there to be 40 megacities, 32 south of the equator. Already today, more than three-quarters of cities with over one million 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 till the end of the century in Africa (see

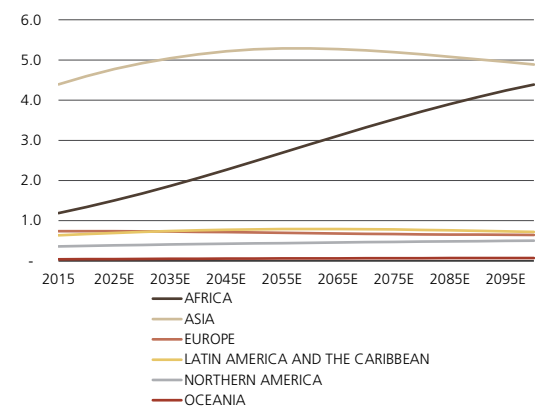
Fig. 1: Urban and rural populations 1950-2050E



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/>

Fig. 2). 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. 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. In the 2000s, it reached 2.2kg and has declined slightly since (2.0kg in 2014, see Fig. 3).

While in the per capital 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. Growth slowed to only 0.03kg/per person per day for every USD 1,000 rise in GDP once the USD 10,000-20,000 range was reached. Several important emerging markets are now in the USD 5,000-10,000 per capita zone (e.g. Brazil, China, Mexico, 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

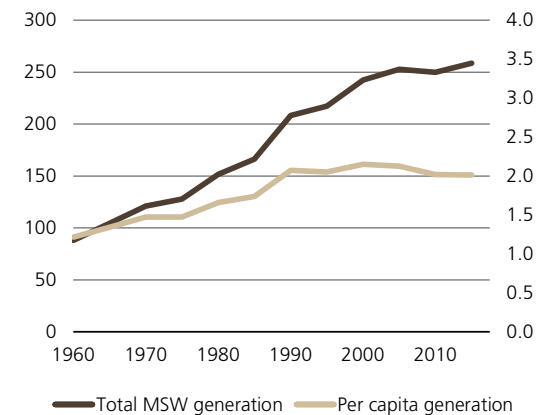
MSW is more commonly known as the trash or garbage discarded daily by the public. After China and the US, the world's largest waste producers are Brazil and Japan (see Fig. 4). In 2010, the high income countries generated 50% of global MSW, but this will change soon. By 2030 Asia will overtake the above 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. One extreme example is Kinshasa in the Democratic Republic of the Congo, which had a population of less than 4 million in 1990, 11 million in 2014 and is projected to have 20 million by 2020. In 2014, it generated more than three times as much waste as it did in 1990, and the volume is expected double again by 2020. The city faces an enormous challenge to expand its waste treatment facilities.

Urban areas in China provide a good example of how this challenge has been met in the last 10 years. Their waste treatment ratio was only 53% in 2006, but it rose to 91.8% in 2014. Close to one-third of the waste was incinerated, compared to only 7.7% in 2006. The combi-

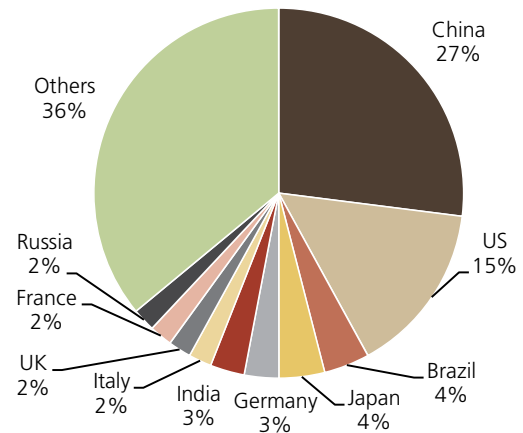
Fig. 3: US municipal solid waste (MSW) generation rates 1960-2014

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 2012E



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

nation 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, which analyst forecasts suggest should reach 13% for 2016-2020, when a penetration rate of 43% will be attained.

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 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 superior opportunities for companies able to take advantage of them.

Recycling

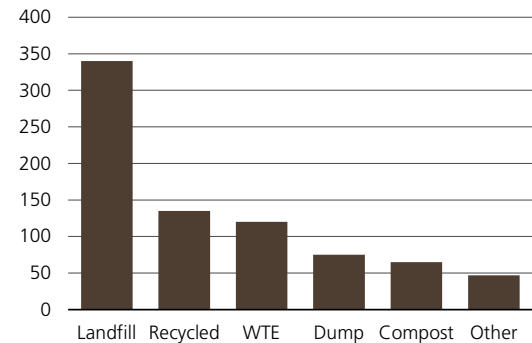
Recycling is an important topic in the waste management theme, as it is one of the most sustainable ways to handle waste. In general, a higher GDP also corresponds with higher recycling ratios. More than 80% of additional waste generation in richer countries is fueled by recyclable material like glass,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

This correlation is also obvious when you compare 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 two million people. The recycling rate there is near 50%.

In some emerging markets the ratio is relatively high due to the fact that there is hardly any 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 entire recycling universe; recycling of electronic waste and plastic packaging is less developed. The recycling industry has been among the waste sub-sectors with the highest growth rates in recent years.

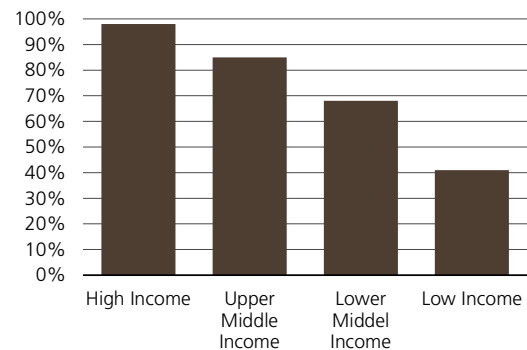
Looking at the profit and loss statement of Umicore S.A – a global market leader in metals recovery and refining – one notices that margins and volumes depend highly on commodity prices and industrial output. Based on UBS analysis, the revenue growth of Umicore's recycling business has had an 80%-plus correlation to a weighted basket of precious and base metals prices over the past 10 years. The higher (lower) metal prices are, the better (worse) it is for recycling companies. Falling metal prices in recent years have pressured their revenues and margins. Hence, the recycling industry is the most cyclical part of the waste management value chain.

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

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

Industrial waste

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

Industrial waste contains several interesting end-markets, such as waste-water and hazardous-waste treatment. In this report we only mention the waste-water market in passing. For more details about it please see our report on Water Scarcity published on 30 May 2016. In emerging markets the treatment of industrial waste water is already fairly advanced. In China, for example, 73% of industrial water is treated. Waste water has been a key focus in recent years, its treatment supported by rising tariffs. On the other hand, the treatment of hazardous waste remains low; less than 60% (2014) of it is responsibly disposed of in China, for instance.

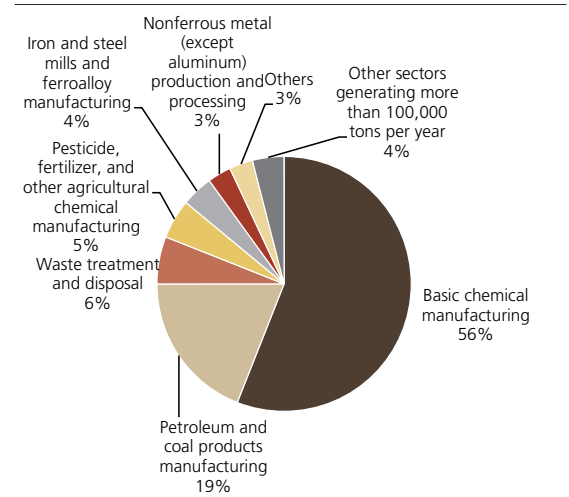
Changing regulations should lead to a surge in treatment volumes. Since January 2013, illegal discharges of hazardous waste have been a criminal offense in China, which wants to raise volumes of treated hazardous waste by more than 75% over 2010 levels (12th five-year plan). Based on market estimates, 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 market, followed by Canada and Brazil. The regulation is less strict than in Europe, but here too recycling rates are comparatively high.

In our view, the hazardous waste segment offers appealing opportunities; typical examples are chemical, medical, nuclear, and oil & gas waste. Fig. 7 provides an overview of the main hazardous waste producers in the US. Stricter regulations and a trend toward outsourcing services make the medical waste sector an attractive market. A few years ago, Ebola garnered a lot of media attention. Though not an important demand driver in developed countries, it illustrates how important the medical waste subsector is.

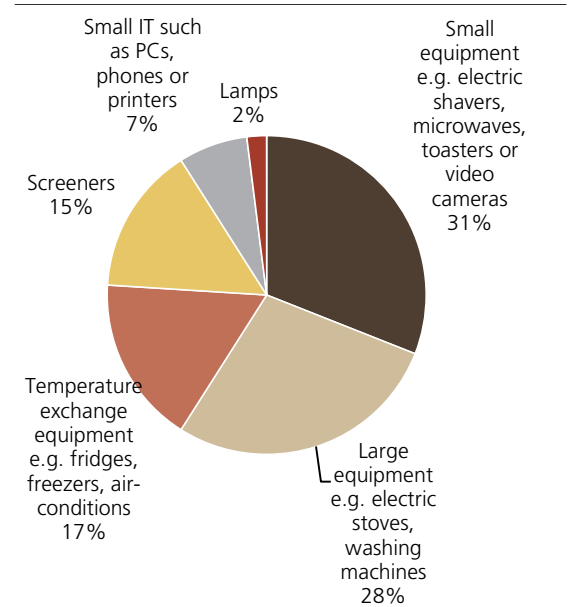
In the oil & gas sector, drilling in unconventional areas (shale gas, oil) produces ever more waste. In particular, the massive increase of "produced water," a by-product of drilling, creates opportunities. Another interesting end-market is the nuclear sector, which globally produces more than 200,000m3 of low and intermediate-level radioactive waste and roughly 10,000m3 of high-level waste. To illustrate, an average 1,000MW nuclear power plant generates 200-350m3 of low and intermediate-level waste per year. In addition to power plants, hospitals and labs produce nuclear waste.

Fig. 7: Sectors in the US generating the largest quantities of hazardous waste
In %



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. 8: Amounts of e-waste generated in 2014, by type
Based on 41.8 million tons of e-waste



Source: Balde, C.P., F. Wang, R. Kuehr, J. Huisman (2015). The global e-waste monitor – 2014. UN University, IAS - SCYCLE, Bonn, Germany.

E-waste – we live in world of gadgets

E-waste is one of the fastest-growing waste markets globally. The market was around 41.8 million tons (Mt) worldwide in 2014, roughly 25% more than 2010. Asia leads with 16Mt, followed by Europe 11.6Mt, North America 7.9Mt, Latin America and the Caribbean 3.8Mt, Africa 1.9Mt and Oceania 0.6Mt. On a per-person basis, the ratio looks different, with Europe the leader (15.6kg/person) and Africa coming up the rear (1.7 kg/person). Small electronic devices (see Fig. 8) 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.

Based on the latest available numbers (2014), only a small part of e-waste is recycled, ca. 40% in Europe, 24% to 30% in China and Japan, 12% in the US and 1% in Australia (source: UN). The rest goes into landfills and incinerators or to waste traders. Tougher regulations and the value of the metals make it a fast-growing market. Volumes are rising at an expectedly fast pace and, by 2018, the UN estimates they will reach 50 Mt. What's problematic is that 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. 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).

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. 10).

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. 9). The hierarchy encourages minimizing greenhouse gas (GHG) emissions. The most sustainable form of "treatment" is outright waste reduction, of course, though other methods also mitigate environmental damage. They includes recycling, aerobic composting and anaerobic digesting.

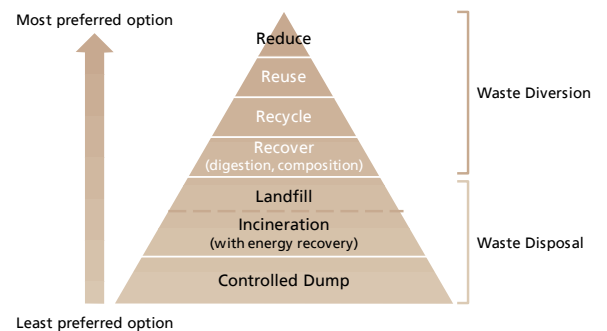
The cheapest and fastest method is waste disposal, which takes the well-known form of landfills or incineration. In most emerging markets these traditional methods are well established. In the case of China, landfills dominate. Due to the time pressure to ramp

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

Fig. 9: Waste hierarchy



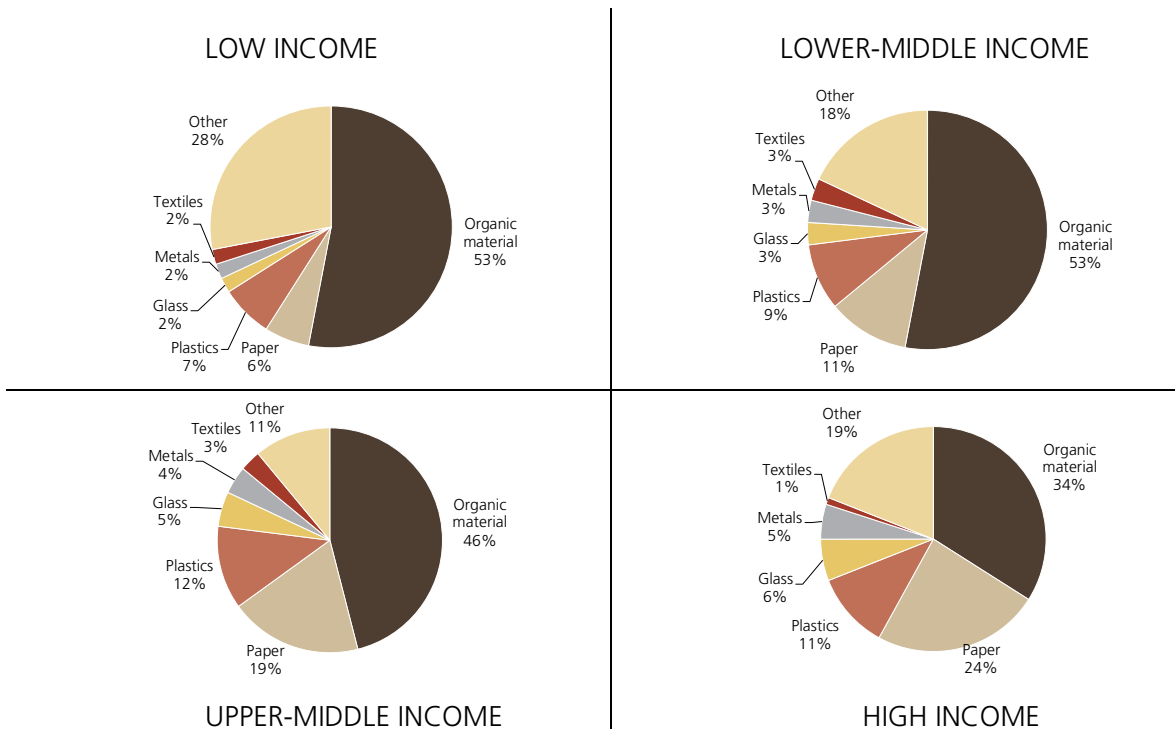
Source: The World Bank (WHAT A WASTE: A Global Review of Solid Waste Management), as of June 2012

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, 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 but not least comes the downstream part, which includes landfills and incineration facilities. In the US, landfills have EBITDA margins between 40% and 60%, depending on the volumes and pricing.

Fig. 10: Waste composition by region



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

Investment opportunity: From trash to cash

We think that waste management is a critical service at the top of many countries' agendas. Uncollected solid waste is a breeding ground for scavenging animals, vermin, insects and diseases that can spread and cause epidemics. Efficient waste management is therefore essential for governments.

Our theme suggests that investors consider industrial, materials and utility companies and selected consumer staple and energy stocks that participate.

Link to sustainable investing

To identify whether a Longer Term Investment (LTI) theme qualifies as sustainable investment (SI) theme, we follow a two-step process. The first works top down. LTIs are assessed according to whether they match one or more of the sustainability topics within the environmental, social or governance (ESG) categories (see Fig. 12). In general, these themes must contribute to environmental sustainability (e.g. a low-carbon economy), resource efficiency (e.g. energy, water), a sustainable society (e.g. health, education, poverty reduction, equality and social inclusion, etc.) or sustainable corporate governance.

The second, bottom-up step consists in considering a thematically aligned representative universe of companies, a large majority of which (80% or more) must align with one or more of the ESG categories. For each individual company, a minimum business involvement threshold is applied, e.g. 25% of revenues must derive from the thematic activity under consideration.

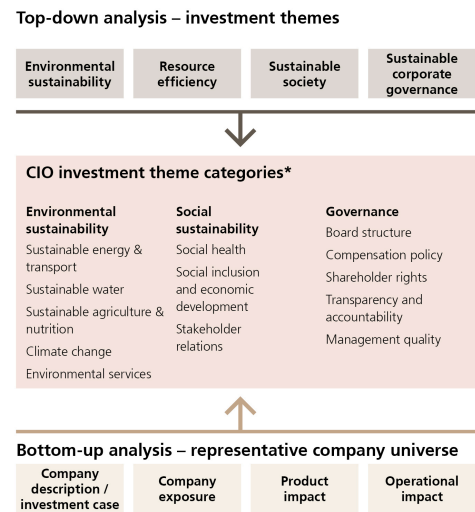
In the report, we discussed the underlying trends of our theme such as population growth, rising living standards, public health, industrialization and EM urbanization, and the tendency toward shorter product life cycles of electronic devices. All this will result in more waste. We think our theme dovetails nicely with the SI thematic framework, addressing in particular environmental sustainability and resource efficiency.

Also, the companies operating in this sector are mainly pure-play waste management and/or recycling companies that cover the framework's environmental and resource-efficiency aspects. The waste topic is also included directly and indirectly in more than half of the 17 UN Sustainable Development Goals (SDGs).

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

Fig. 12: Overview of LTI topic clusters



* For simplicity, all topic clusters include several subcategories not included in the graph. For example: sustainable water includes water utilities, treatment, desalination, infrastructure & technology, water efficiency and ballast-water treatment. Within each subcategory are further specifications; e.g. water treatment includes filtration, purification and waste treatment. In total, we have more than 100 categories (potential sustainable investment themes) in our thematic database. Source: UBS

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 expect the EPS outperformance relative to the broader MSCI World index to continue over the next cycles. 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, our 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. 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	E	expected i.e. 2011E
EBITDA	Earnings before interest, taxes, depreciation and amortization	EPS	Earnings per share
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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