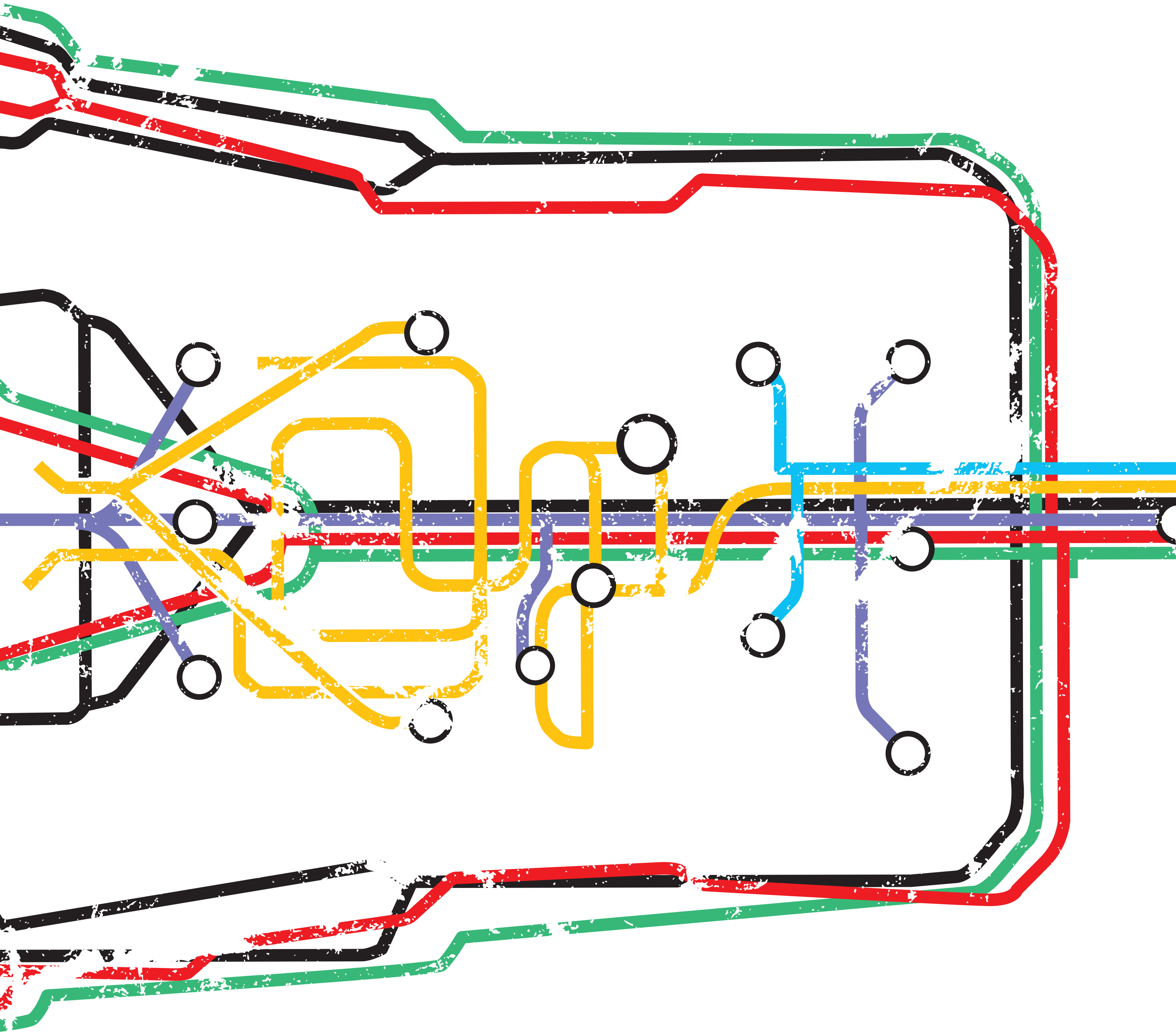
VITAL WASTE GRAPHICS 3



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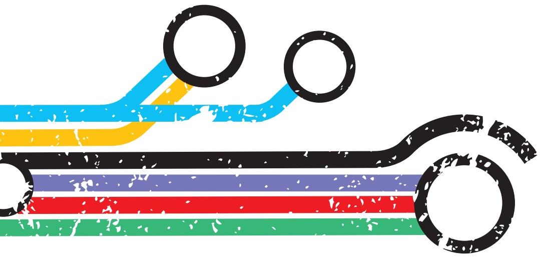

Cover illustration
Waste Body Burden 'Metro Map'. Source: Silicon Valley Toxics Coalition; Metro lines adapted from Sam Loman (see p. 27).

This is a publication of the Secretariat of the Basel Convention prepared by Zoï Environment Network and GRID-Arendal.

The **Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal** is the most comprehensive global environmental agreement on hazardous and other wastes. It aims to protect human health and the environment against the adverse effects resulting from the generation, management, transboundary movements and disposal of hazardous and other wastes. www.basel.int

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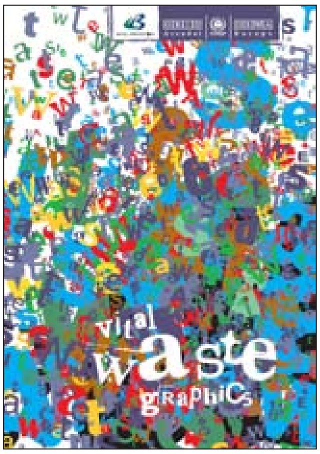
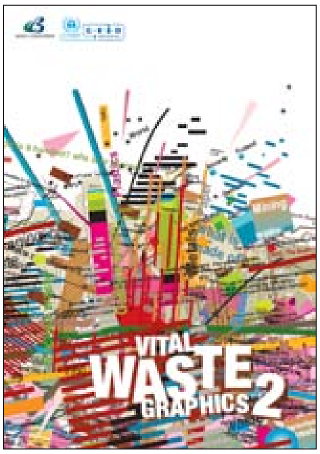
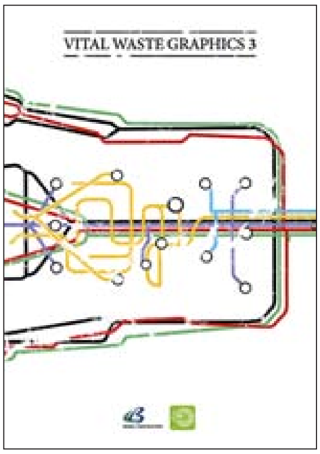


Vital Waste Graphics (2004)



Vital Waste Graphics 2 (2006)



Vital Waste Graphics 3 (2012)

Vital Waste Graphics 3 has a deliberately wider scope than the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal. From generation to disposal, waste is a by-product of societal dynamics, and all too often absent from our consideration. Vital Waste Graphics 3 seeks to put waste in context by:

- looking at some of the forces driving global trends;
- examining various concerns and the strategies developed to address them;
- considering the difficulties encountered in implementing these strategies.

Foreword

With more people living on this planet, more consumption, more waste, more pollution, less land available for landfills, and fewer resources, what will we do with all the waste?

Because these elements are connected, it is our responsibility, as consumers and producers, to rethink our consumption and production patterns and, where appropriate, modify trends and shape the development of our society into more sustainable pathways. Decisions taken today determine the choices and solutions available tomorrow. Within this web of interconnected factors, waste represents a major node, one that cannot be considered separately from other global issues such as resource sustainability. As a by-product of our activities, waste can represent a significant burden for human society and the environment.

The most obvious way to begin reducing this burden is through finding opportunities to use waste as a resource, transforming this burden into a challenge and an opportunity. This simple idea of 'closing the loop' and evolving from 'cradle-to-grave' to 'cradle-to-cradle' has already spread spontaneously across various sectors of the economy, especially in the informal sector of many developing countries. The waste management sector can contribute to generating national income, instead of hampering it. While the economic benefits are often readily perceived, the social and environmental costs of these activities need to be made explicit in economic calculations. We need to have a broader vision for the future that accommodates new developments and realities as well as ensures that unavoidable wastes that are general are managed in an environmentally and socially responsible manner.

To address the numerous issues highlighted in this publication, all actors need think in terms of integrated waste and resource management on both the local and global scales. Many options have been and are being developed to translate our shared responsibility into effective measures. The trends identified in this report hold interesting prospects for society in general as well as for business, in terms of innovation, job opportunities and sustainability.

Jim Willis
Executive Secretary
Basel, Rotterdam and Stockholm Conventions

GLOBAL TRENDS

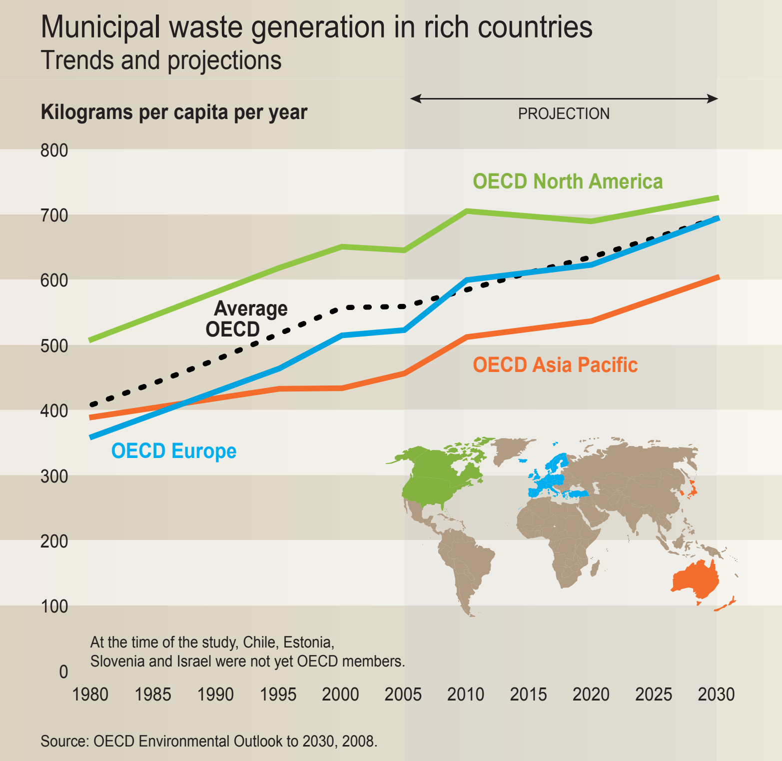
THE WASTE HEAP

The world population is steadily increasing, consumption levels are growing, and as a result the global waste heap is getting bigger and bigger. Despite the economic difficulties faced by several countries, global trends for waste are clearly on the rise; and forecasts for 2050 indicate that these are long-term trends.

By the middle of the century, 9 000 million human beings on the planet are expected to generate over 13 100 million tonnes of waste – about 20 per cent more than in 2009. The general rule is that the rich produce more waste; but a certain level of development allows for some decoupling of economic growth and waste production (cleaner production; waste prevention campaigns).

This increase in waste generation is most apparent in urban areas. Today more than 50 per cent of the world's population lives in cities. By 2050 this number is expected to rise to around 70 per cent, with 50 per cent of this total urban population in Asian countries.

Development of urban areas across the world, which is especially strong in emerging and developing countries, will pose significant challenges for policy-makers. Transport, housing, energy and

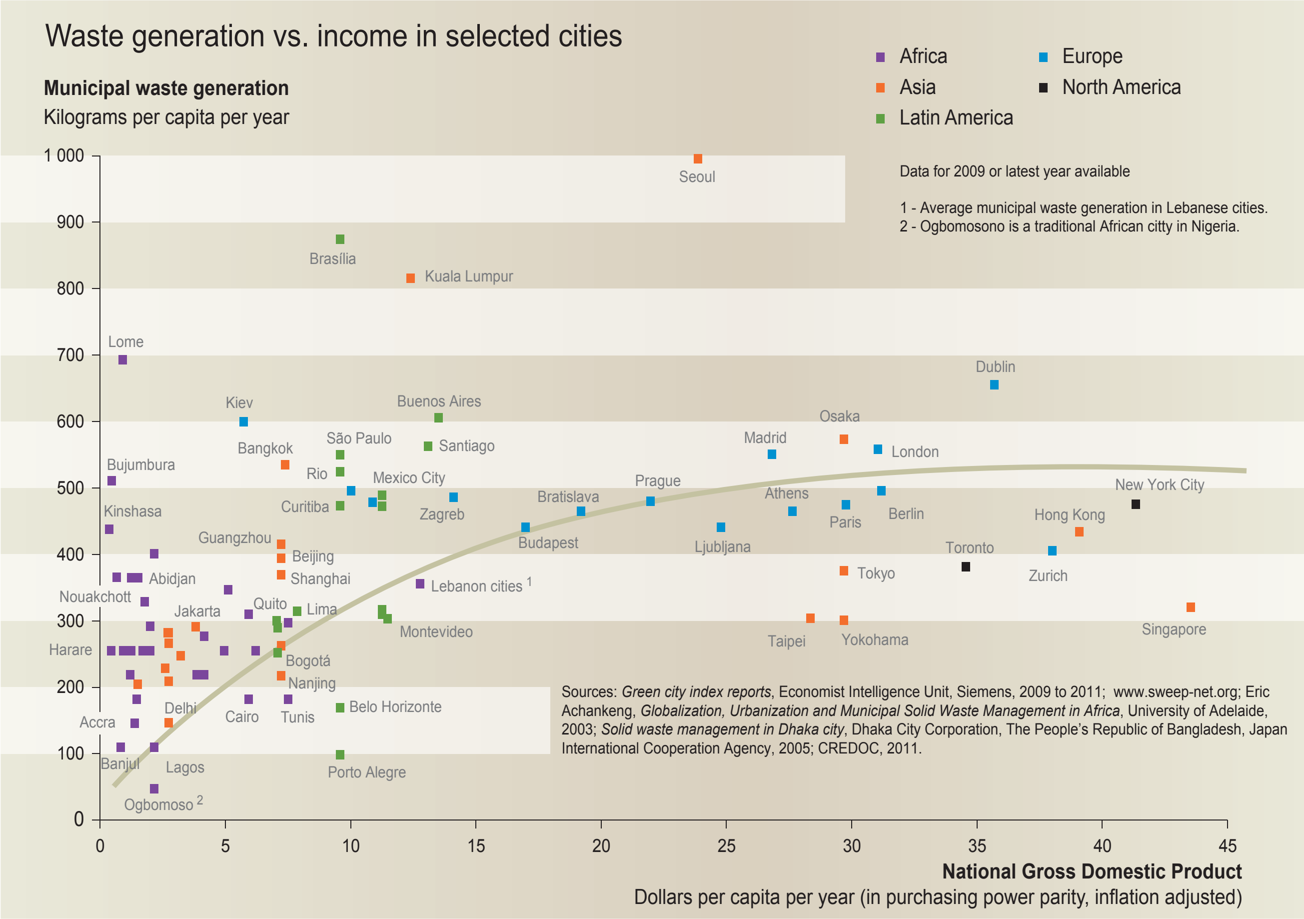


Municipal waste generation in rich countries

Trends and projections

At the time of the study, Chile, Estonia, Slovenia and Israel were not yet OECD members.

Source: OECD Environmental Outlook to 2030, 2008.



Waste generation vs. income in selected cities

Data for 2009 or latest year available

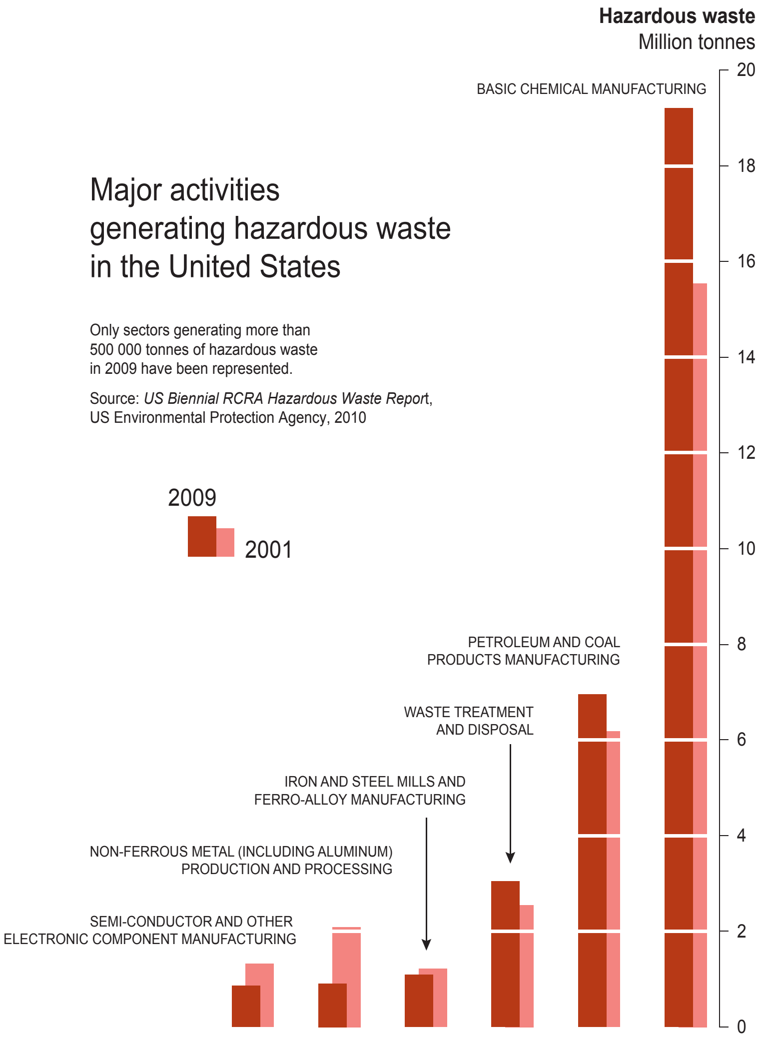
1 - Average municipal waste generation in Lebanese cities.
2 - Ogbomosono is a traditional African citty in Nigeria.

Sources: *Green city index reports*, Economist Intelligence Unit, Siemens, 2009 to 2011; www.sweep-net.org; Eric Achankeng, *Globalization, Urbanization and Municipal Solid Waste Management in Africa*, University of Adelaide, 2003; *Solid waste management in Dhaka city*, Dhaka City Corporation, The People's Republic of Bangladesh, Japan International Cooperation Agency, 2005; CREDOC, 2011.

Major activities generating hazardous waste in the United States

Only sectors generating more than 500 000 tonnes of hazardous waste in 2009 have been represented.

Source: *US Biennial RCRA Hazardous Waste Report*, US Environmental Protection Agency, 2010



resource demand, and of course, waste management, top the list of these challenges. Cities concentrate a high level of economic activities, with higher incomes and therefore high levels of consumption. This, in turn, is reflected in the considerable volume of waste produced annually compared to other areas.

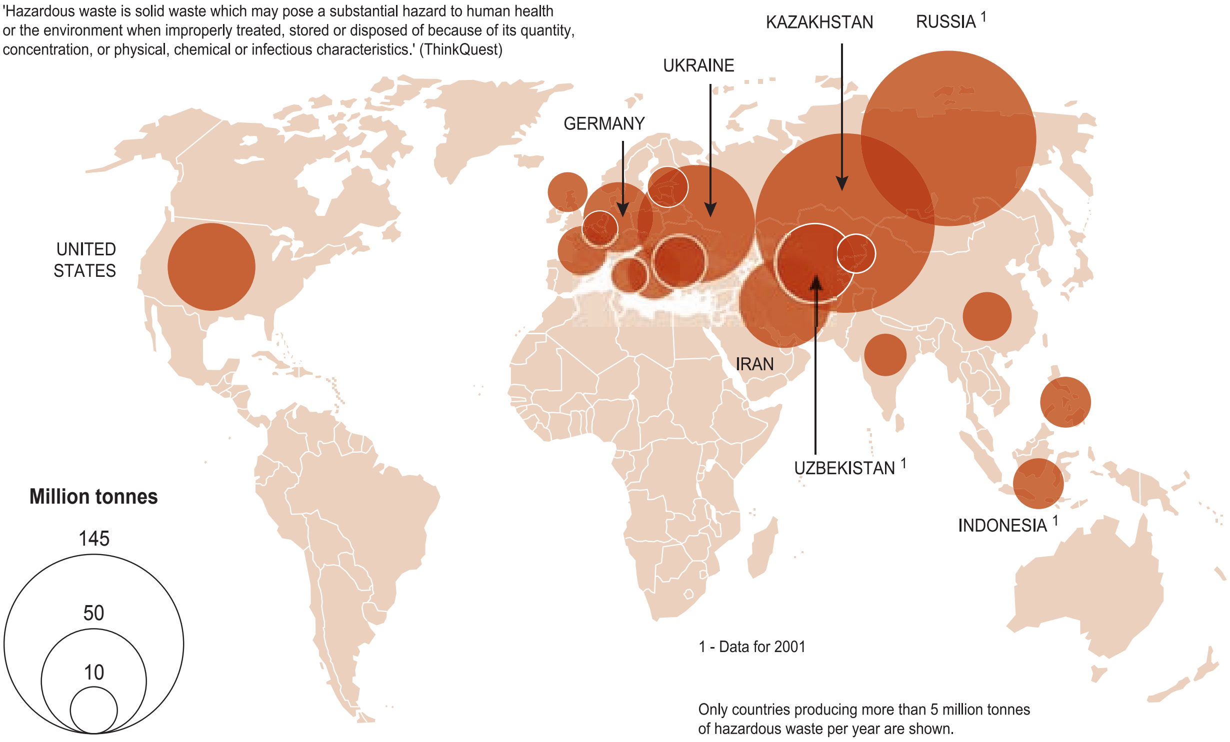
Beyond volume, a matter of content: the threat of hazardous wastes

Hidden in the global trend, hazardous waste generation poses a serious threat to human health and the environment. In addition, despite the various regulations in place and the monitoring mechanisms they imply, no exhaustive data can currently provide a clear overview of global hazardous waste generation, the exact sources and substances, the volumes and handling methods. Considering the significant potential for harm from hazardous waste, the present situation gives rise to legitimate concerns.

Major hazardous waste producers (countries for which data are available)

Please be careful when interpreting this map: wastes, other that those listed in Annex I and II of the Basel Convention, that can be considered or defined as hazardous differ from one country to the next.

'Hazardous waste is solid waste which may pose a substantial hazard to human health or the environment when improperly treated, stored or disposed of because of its quantity, concentration, or physical, chemical or infectious characteristics.' (ThinkQuest)



1 - Data for 2001

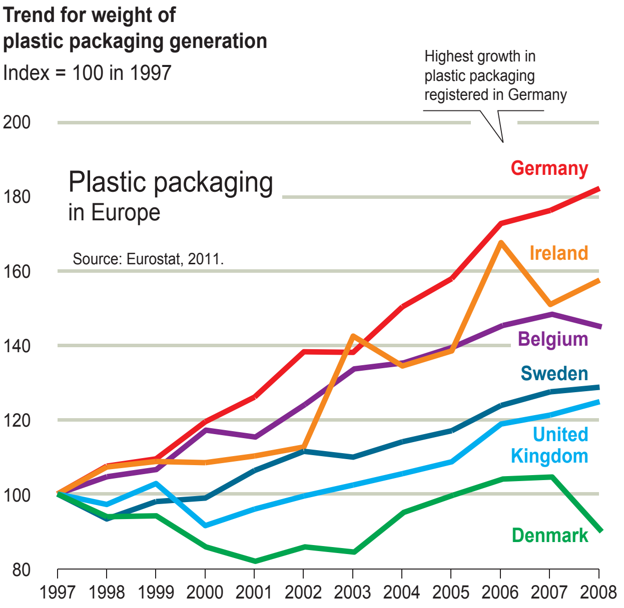
Only countries producing more than 5 million tonnes of hazardous waste per year are shown.

Sources: Basel Convention, 2011 (data for 2007 or latest year available); *Environmental Indicators,* United Nations Statistics Division, 2009; Eurostat 2011 (data for 2008 or latest year available); Philippe Chalmin, Catherine Gaillochet, *Du rare à l'infini. Panorama mondial des déchets 2009.*

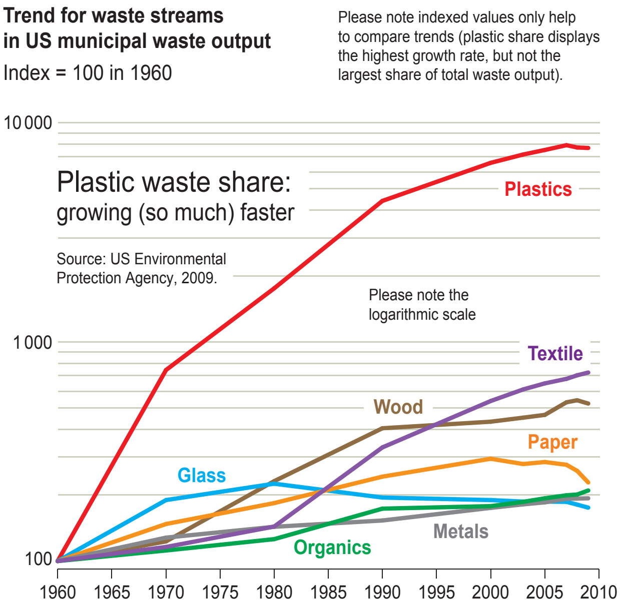
DARK SIDE OF A MODERN WORLD

Major concerns have emerged around the world, in particular about the fast soaring stocks of plastic waste, and electronic and electrical wastes – or e-waste. From packaging to the transportation industry, more and more materials are being replaced by their polymer or plastic counterparts, still almost exclusively produced from oil. The increase of crude oil prices seems to have little effect on this trend. Indeed the value of the physical and chemical properties of plastics far outweighs production costs.

Resistant to degradation, plastics are also lighter than most other materials and can take any shape and any colour. Because of a strong market niche, plastics are becoming increasingly ubiquitous. The main distressing side-effect of this success swims in the planet's oceans. The slow degradability of plastics allows these materials to 'withstand the ocean environment for years to decades or longer.' Where large surface currents – gyres[1] – converge, plastic waste forms entire floating islands of marine debris; but their precise distribution and impacts are much less obvious to the human eye, and hence poorly documented. Marine fauna ingest plastic or become entangled in it. Plastic also absorbs persistent organic pollutants (POPs)[2] from the environment and eventually transfers them back to it. The main source of this pollution is apparently land-based, considering the increasing

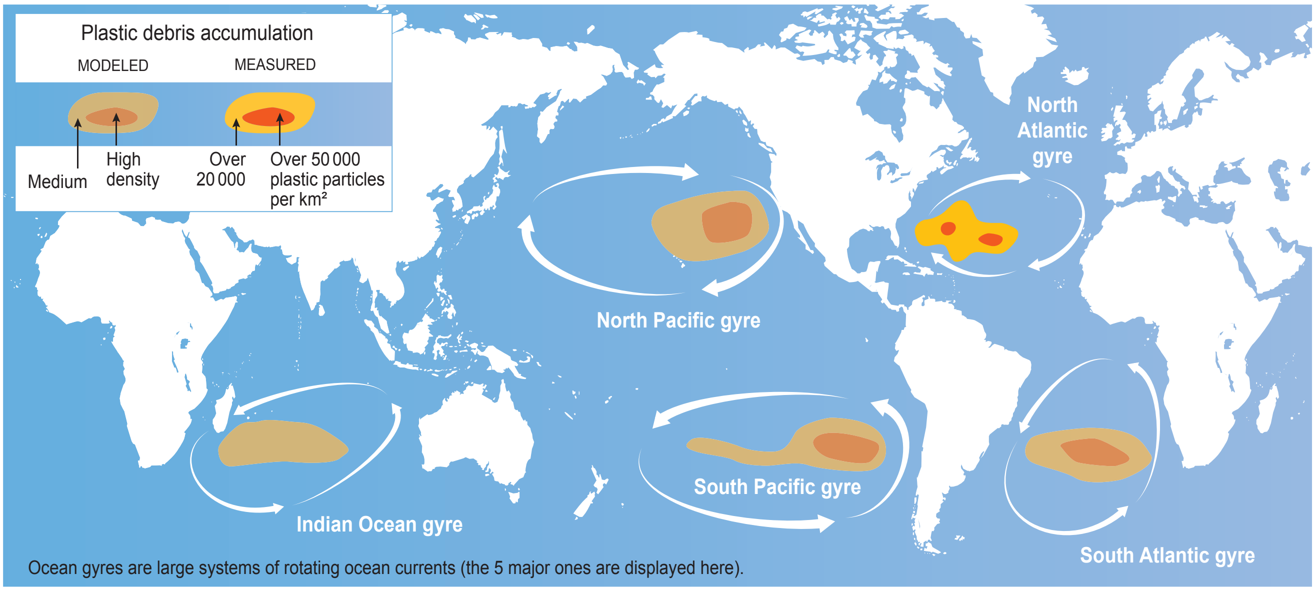

Trend for weight of plastic packaging generation

Index = 100 in 1997


Trend for waste streams in US municipal waste output

Index = 100 in 1960

Please note indexed values only help to compare trends (plastic share displays the highest growth rate, but not the largest share of total waste output).



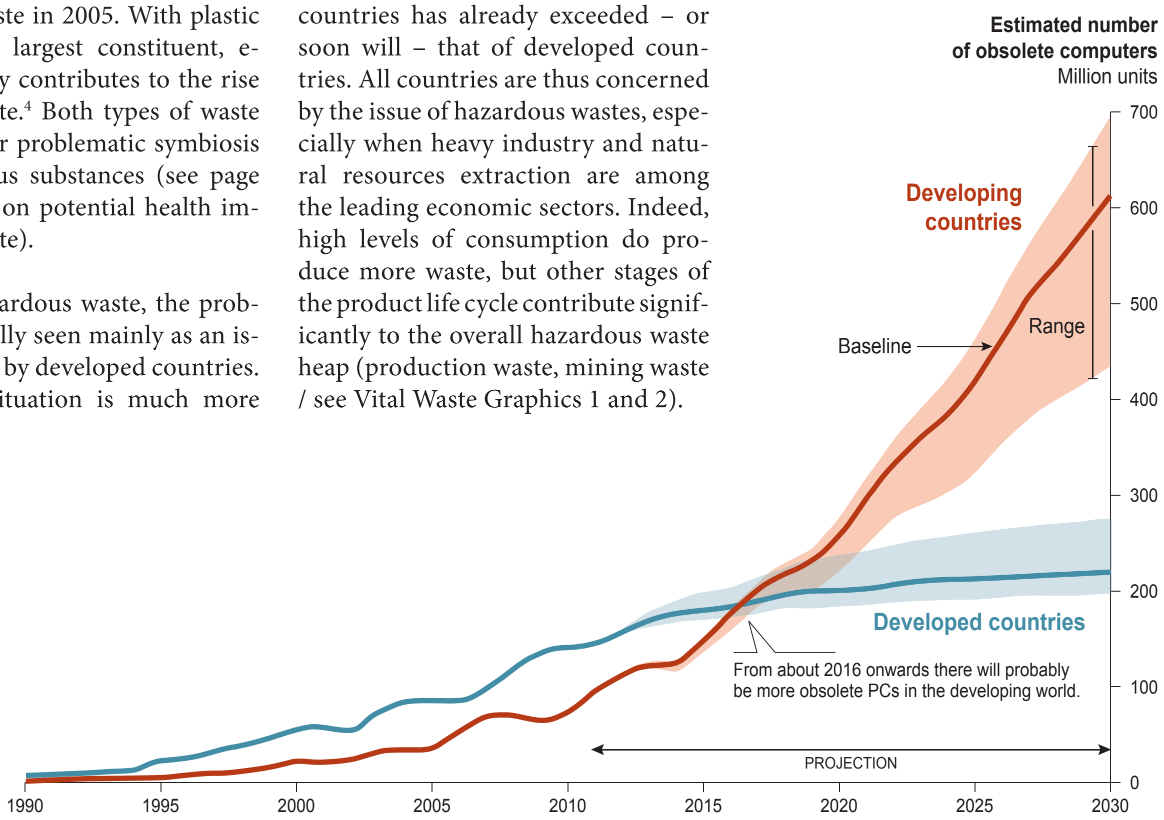
Ocean gyres are large systems of rotating ocean currents (the 5 major ones are displayed here).

Sources: Nickolai Maximenko et al. cited in Tracking Ocean Debris, IPRC Climate, Newsletter of the International Pacific Research Center, 2008; Kara Lavender Law et al., Plastic Accumulation in the North Atlantic Subtropical Gyre, Science, September 2010; US National Oceanic and Atmospheric Administration (NOAA) Marine Debris Program, 2010; www.5gyres.org.

world production of plastics and their growing share in municipal waste.[3]

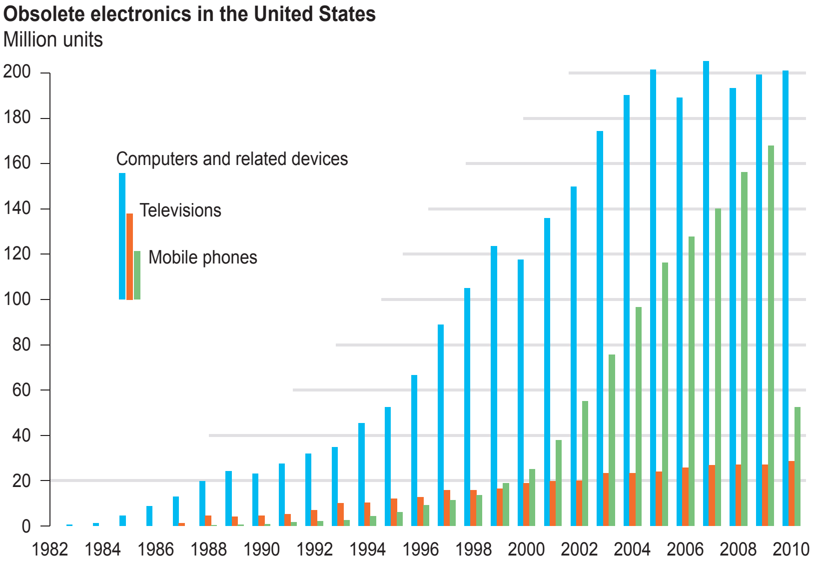
As for end-of-life electrical and electronic products, e-waste already constituted an estimated 8 per cent of municipal waste in 2005. With plastic as its second largest constituent, e-waste certainly contributes to the rise in plastic waste.[4] Both types of waste share a similar problematic symbiosis with hazardous substances (see page 27 for details on potential health impacts of e-waste).

As for all hazardous waste, the problem was initially seen mainly as an issue of exports by developed countries. In fact the situation is much more complex, and developed countries cannot solve the problem by themselves. Plastics are massively produced all over the world; and the volume of obsolete personal computers or mobile phones generated in developing countries has already exceeded – or soon will – that of developed countries. All countries are thus concerned by the issue of hazardous wastes, especially when heavy industry and natural resources extraction are among the leading economic sectors. Indeed, high levels of consumption do produce more waste, but other stages of the product life cycle contribute significantly to the overall hazardous waste heap (production waste, mining waste / see Vital Waste Graphics 1 and 2).

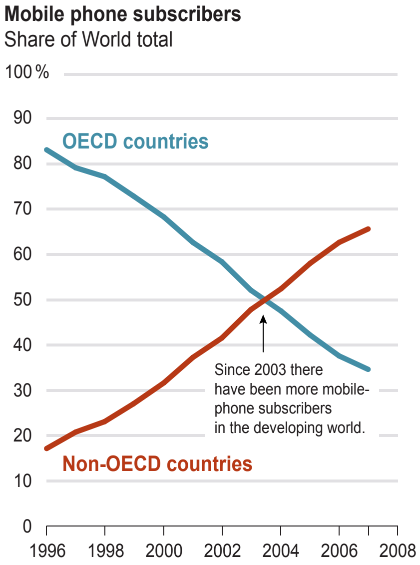


Source: Yu et al., *Forecasting Global Generation of Obsolete Personal Computers*, Environmental Science & Technology, 2010.

Forecasting generation of obsolete computers



Source: *Electronics Waste Management In the United States, Approach 1*, U.S. Environmental Protection Agency Office of Solid Waste and Eastern Research Group, 2008.



Source: OECD Factbook 2010.

DO WE REALLY WANT TO MINIMIZE WASTE?

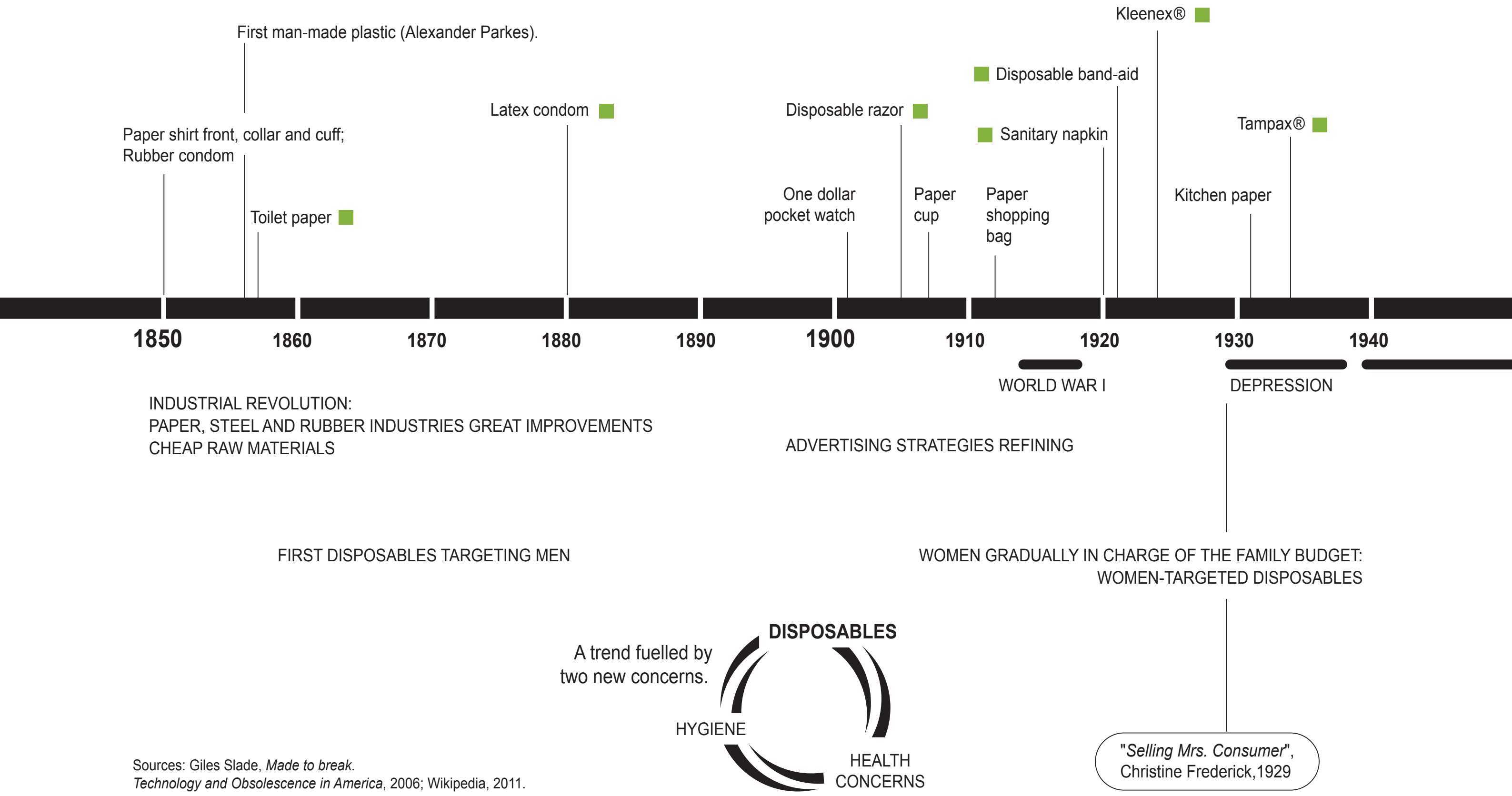
HAPPY THROWING AWAY, MR AND MRS CONSUMER!

In response to the challenges posed by the growing waste heap, the concept of minimization – or prevention – of waste generation has been developed in major international texts and public policies on waste management. The Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal, the Organization for Economic Co-operation and Development (OECD), the European Environment Agency (EEA) or the United States Environment Protection Agency (EPA), for instance, all identify minimization as one of the topics on which to focus action against the growing problem of waste.[5] Global trends, however, do not confirm any general consensus on when and how to achieve this objective.

A number of obstacles prevent the practical implementation of waste minimization. The most prominent are the manufacturing strategy of 'planned obsolescence', related consumption behaviour and surprisingly, the waste market itself.

The core of the problem is certainly systemic. Many products need to be changed after a certain period of time. In a system in which production must increase steadily to cover credit interest payments and further investments, a limited service life allows the manufacturer to produce replacements, thus securing a regular revenue stream. The constant search for profitability also drives manufacturers and producers to look for production methods which save resources, energy and time. Although generally considered positive, this approach becomes problematic when durability is deliberately sacrificed for the sake of production gains. The strategy of planned obsolescence – shortening a product's lifespan, manufacturing 'made to break' items or single-dose goods – undeniably leads to an increase in

The advent of the throw-away culture
A selected history of disposables in the United States



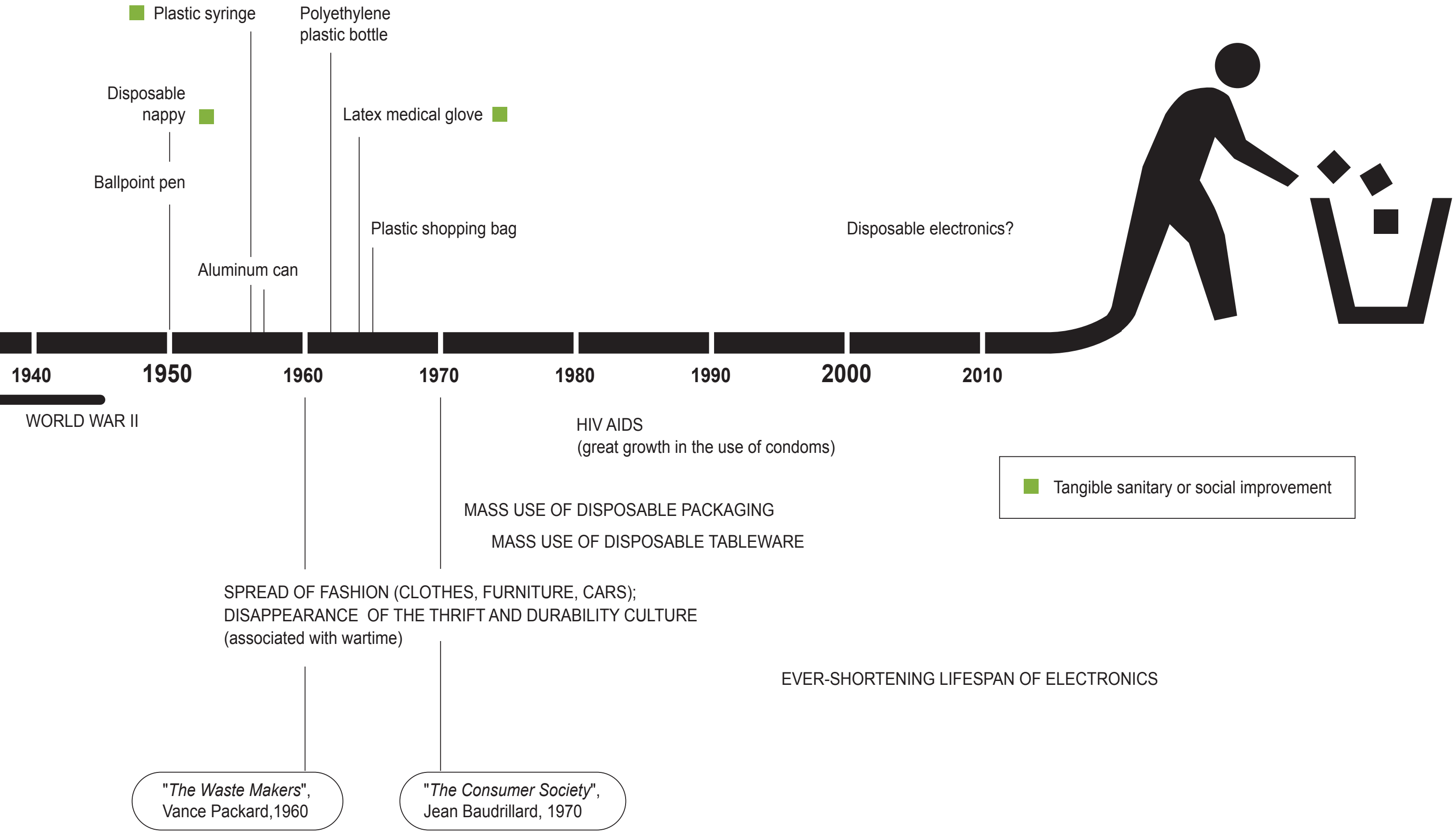
Sources: Giles Slade, *Made to break. Technology and Obsolescence in America*, 2006; Wikipedia, 2011.

resource consumption and consequently more waste.

On the other hand, when new products offer higher performance or greater energy efficiency, for instance, a change may reduce the overall environmental impact. Indeed, the use-phase of certain electronic products carries significant weight in their Life Cycle Assessment (LCA). The presence (or lack) of sound waste management methods can nevertheless alter the final verdict. To avoid counter-productive effects, environmental regulations on product efficiency and quality must also take into account the end-of-life of products.

Happiness versus consumption

Are high consuming, therefore high waste producing, societies happier? The satirical model developed by Colin Beavan, aka 'No Impact Man', illustrates the much discussed relationship between happiness and consumption. At what point ('the goal') does growth become useless and even harmful to our well-being, when objects, things, 'stuff' take over our lives?

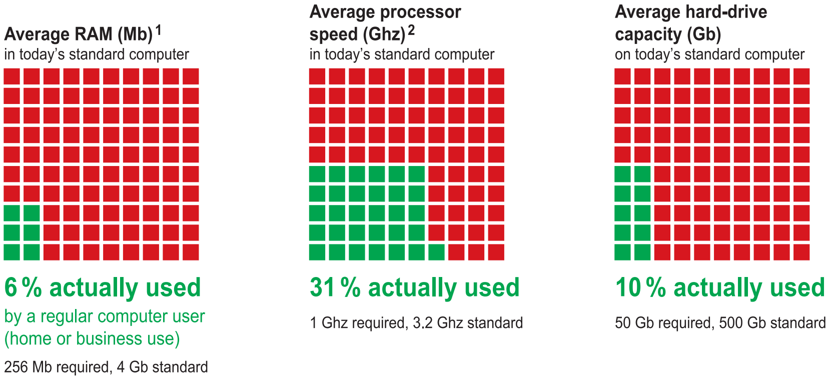


DO WE REALLY WANT TO MINIMIZE WASTE?

NOW, UPGRADE!

In recent decades the remarkable development and increased functionalities of computer software and hardware have caused an exponential increase in the rate at which computers become obsolete (see page 9). Regular replacement is now unavoidable, contributing with the growing total number of computers to the rising generation of e-waste.

The technology race: where will this lead to?



Theoretical calculations based on the following applications: internet browsing, word processing, spreadsheet and image editing, watching videos, with adequate space to store data. Making allowance for video gaming would significantly change the results. Data compiled in March 2011.

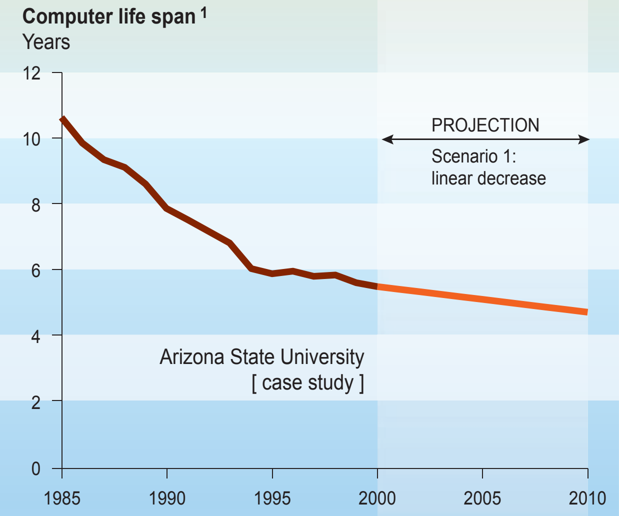
1 - Random-access memory, measured in megabytes, is needed to run software; 2 - Gigahertz.

Sources: Mozilla, Microsoft, Google, 2011.

The reasons for replacement include both internal (a component breaks) and external factors (changes in fashion or technology make previous items unusable or simply obsolete). Such obsolescence has had systemic impacts not only on production but also on consumption patterns.

While functional reasons (e.g. technical obsolescence, technological innovation) provide a major part of the explanation for the replacement rate, the importance of fun and social status attached to the adoption of the newest electronic products represents also a significant driver for obsolescence.[6] Computer technologies come thus closer to common electrical products, despite the difference in technology level involved, the significant resource consumption and the environmental impacts attached to the computer life cycle. We should not underestimate the social obstacles to minimizing the waste this entails.

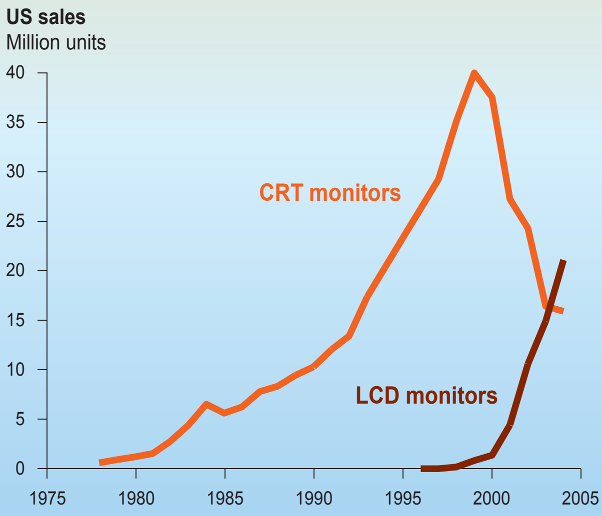
Shortening life spans
University computers case study



1 - From purchase to disposal.

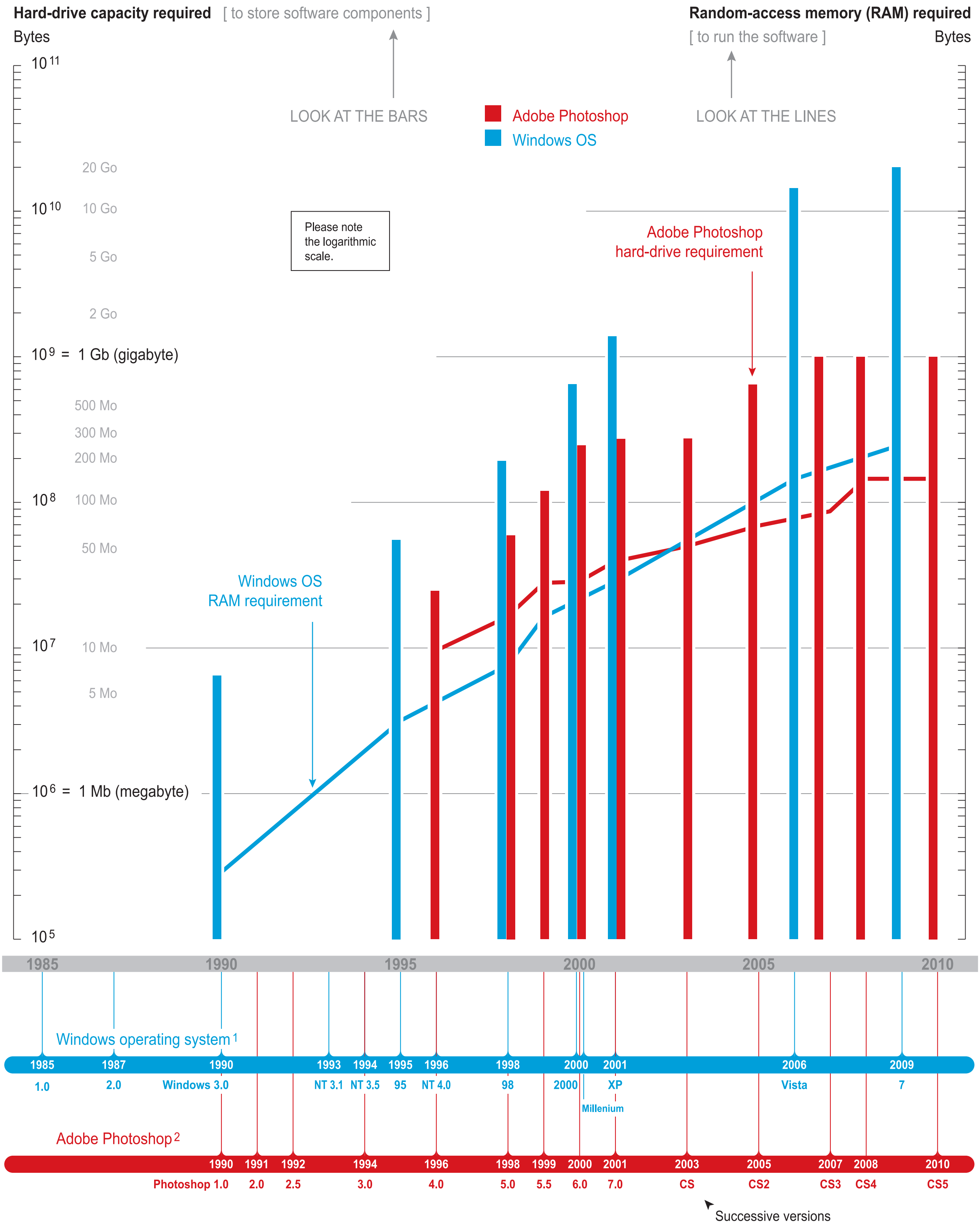
Source: Callie W Babbitt et al., *Evolution of Product Lifespan and Implications for Environmental Assessment and Management: A Case Study of Personal Computers in Higher Education*, Environmental Science & Technology / Vol. 43, No. 13, May 2009

Technical obsolescence
The end of cathode-ray tubes?



Source: *Electronics Waste Management In the United States, Approach 1*, Office of Solid Waste of the U.S. Environmental Protection Agency and Eastern Research Group, 2008.

Upgrades: how much is really needed?



[TWO POPULAR SOFTWARES]

1 - Software "organizing" the overall running of a computer (user interface).
"NT" and "DOS" systems developed in parallel between 1993 and 2000.
2 - Image editor (Mac users only before1992).

Sources: Microsoft, Adobe, Wikipedia, 2011.

TAKING ACTION

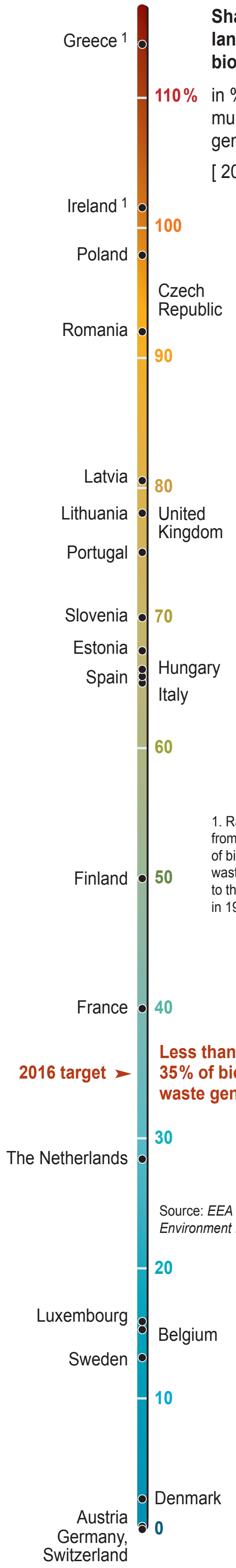
Diagnosis of the growing waste heap reveals little sign of a bright future. Nevertheless strategies and tools exist to regain control and ultimately change global trends. Most need resources for their implementation, but everything depends on one of them: the willingness to change.

Governments and other public authorities are responsible for framing national and global strategies to solve the problems caused by waste. They alone possess the political legitimacy to implement effective and fair frameworks allowing such development, using regulations, and financial or legal incentives. These incentives can take the form of waste taxes, for instance, or norms and standards, either imposed by the authority or developed by the private sector (ISO standards). Of course problems of governance have a significant impact on the way authorities respond to this challenge and assume their responsibility. An inadequate response to an issue, such as waste management, may result from a deliberate refusal to tackle the problem; but such an outcome often arises due to a lack of capacity for implementation. Enforcement strategies are the keystone for the success of any state policy, putting into practice the laws on statute books. Building capacity so that this can happen everywhere is a titanic task which requires substantial funding, and changes in habits and policies.

Share of landfilled biodegradables

in % of biodegradable municipal waste generated in 1995

[2006 status]

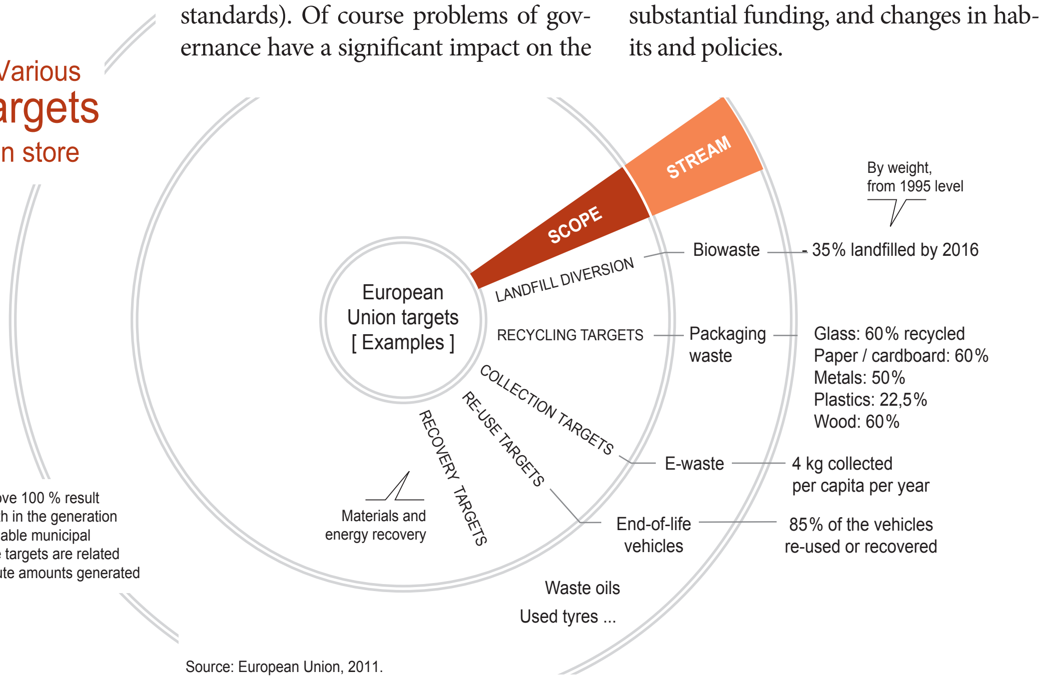


1. Rates above 100 % result from a growth in the generation of biodegradable municipal waste as the targets are related to the absolute amounts generated in 1995.

Less than 35% of biodegradable municipal waste generated in 1995

Source: *EEA State of the Environment Report 2010.*

Various **targets** in store



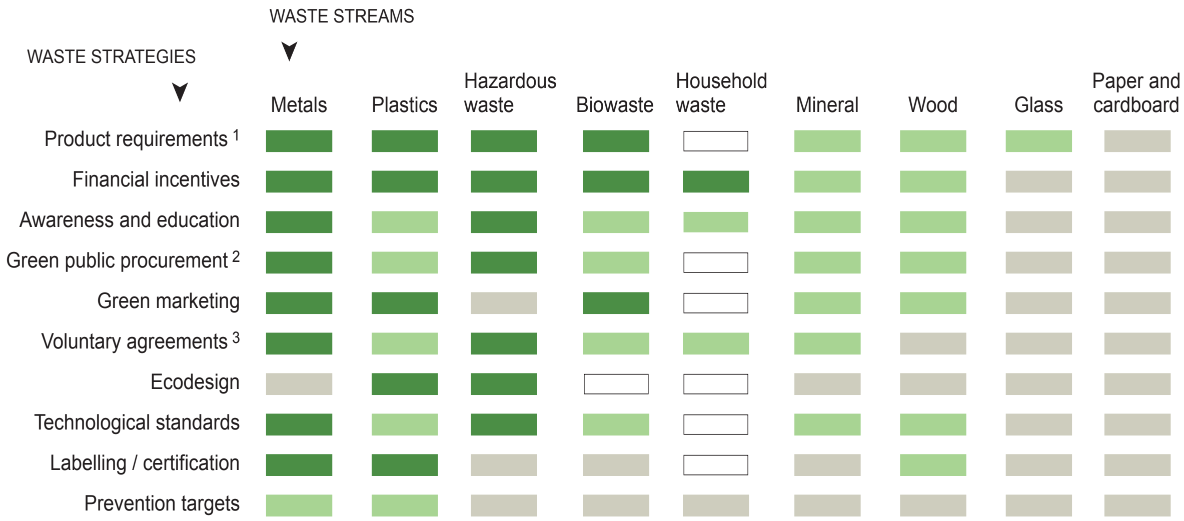
Source: European Union, 2011.

Minimizing waste versus preventing waste

The distinction between the two terms is still not settled. It is nevertheless crucial to distinguish between end-of-life actions such as waste management measures, and preventive measures to reduce waste production itself. By the time waste has been produced, resources (energy, materials) have already been consumed, and a number of impacts on humans and the environment have already occurred. It is too late for significant changes. In that sense, recycling and incineration, for instance, do reduce the amount of waste going for landfill – a diversion often associated with minimization. These operations, necessary as they are, do not help limit the actual generation of waste; they simply allow us to limit the occurrence of further impacts. Ultimately real prevention would mean changing not only the way we manufacture products, but also the way we produce waste, in other words, consumption.[7] For instance, European targets for reducing the portion of biodegradable waste in municipal solid waste can be categorized as a waste minimization strategy. Beyond the obvious reduction of space required for landfill, the objective is twofold: to reduce emissions from landfill, but also to encourage energy and material recovery from organic waste (see pages 20-21 on organic waste). But the energy and material saved can often be 're-invested' to boost production, thus limiting the expected overall reduction in impacts. This 'rebound effect' or 'Jevons paradox,'[8] underlines the importance of preventive measures as opposed to only focusing on end-of-life actions.

Preventive tools for each stream

■ Very efficient strategy for specific stream
▨ Useful strategy
▒ Inefficient strategy
☐ No data or data not applicable



WASTE STRATEGIES \ WASTE STREAMS	Metals	Plastics	Hazardous waste	Biowaste	Household waste	Mineral	Wood	Glass	Paper and cardboard
Product requirements [1]	■	■	■	■	☐	▨	▨	▨	▒
Financial incentives	■	■	■	■	■	▨	▨	▒	▒
Awareness and education	■	▨	■	▨	▨	▨	▨	▒	▒
Green public procurement [2]	■	▨	■	▨	☐	▨	▨	▒	▒
Green marketing	■	■	▒	■	☐	▨	▨	▒	▒
Voluntary agreements [3]	■	▨	■	▨	▨	▨	▒	▒	▒
Ecodesign	▒	■	■	☐	☐	▒	▒	▒	▒
Technological standards	■	▨	■	▨	☐	▨	▨	▒	▒
Labelling / certification	■	■	▒	▒	☐	▒	▨	▒	▒
Prevention targets	▨	▨	▒	▒	▒	▒	▒	▒	▒

1 - Prohibited toxic substances, packaging or volume requirements, etc.
2 - Green organizations and public spending.
3 - Environmental targets set in consultation with industry.

Source: adapted from Arcadis, *Analysis of the evolution of waste reduction and the scope of waste prevention*. A report for the European Commission, 2010.

What is waste for some, is a business opportunity for others. Indeed, those who produce waste must dispose of it, usually paying for its removal and/or treatment. These costs, however, turn into revenue for other economic activities. Such actors may therefore not welcome – may even oppose – the overall idea of reducing waste production at source. On the other hand, the production of limited but more homogenous and higher quality waste should prompt more positive reactions. Apart from transport, the cost of recovery, recycling and other waste-related activities should drop, thus improving the profitability of these operations as environmental policies (public, private) slowly turn waste into a resource.

Waste costs vs. Waste revenues

DIRECT EXPENDITURES

Education / awareness

Waste management See pp. 22-23
- Collection
- Sorting
- Transport
- Treatment
- Disposal

Technical research

Prospective analysis

EXTERNALITIES

Climate change See pp. 24-25

Biodiversity losses

Loss of ecosystem services

Health costs See pp. 26-27

REVENUES

Sale of recyclables or by-products from recycling See pp. 16-21

Sale of biogas from energy recovery (at landfill or incinerators) See p. 20

Waste taxes and tipping fees at landfill See p. 33

Waste sector funding (firms, governments, institutions) See p. 41

Is waste too profitable to reduce?

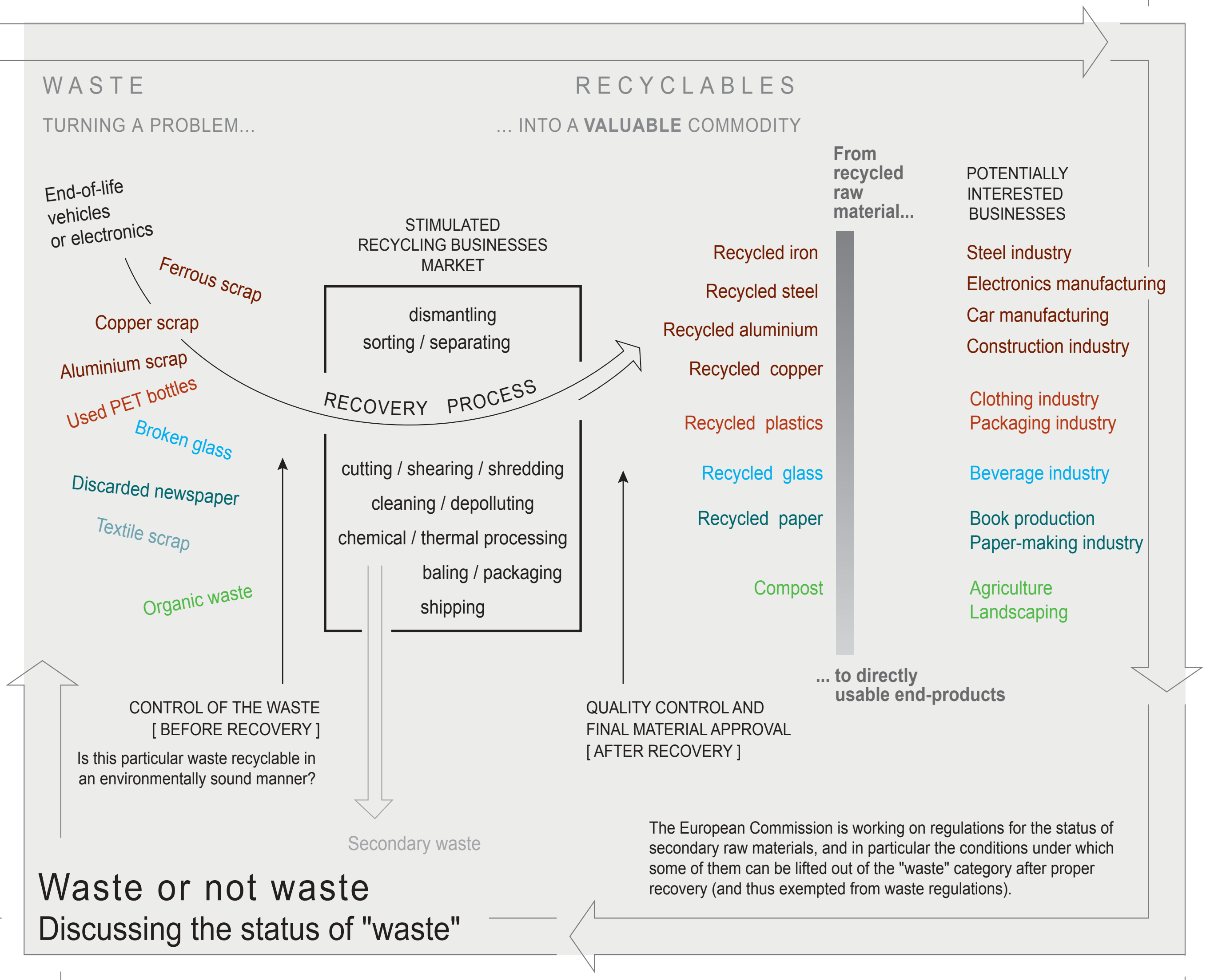
Public costs
Private revenues

WASTE WORTH BILLIONS

At present, commodity prices are high and state regulations regarding waste have been developed in many countries.[9] As a result of one or both conditions, many jobs and activities benefit from waste. The most numerous are probably informal waste pickers working on landfills in many cities in the developing world. Considering the size of the (legal and illegal) waste market, its economic value, the number of actors and jobs involved, one may wonder how great an obstacle this represents to progress towards much needed reduction of waste generation. A change in the current trend could certainly raise major social and economic issues.

In simple economic terms, little profit can be derived from an item produced in significant volume but with little intrinsic value. Indeed, most manufactured goods lose their initial function when they are consumed or used, bringing down the value of each item to that of its constituent materials. Such is the basic characteristic of waste. So how can the global waste market, worth an estimated US$300 000 million a year, be so profitable? How can waste turn into a tradable good?

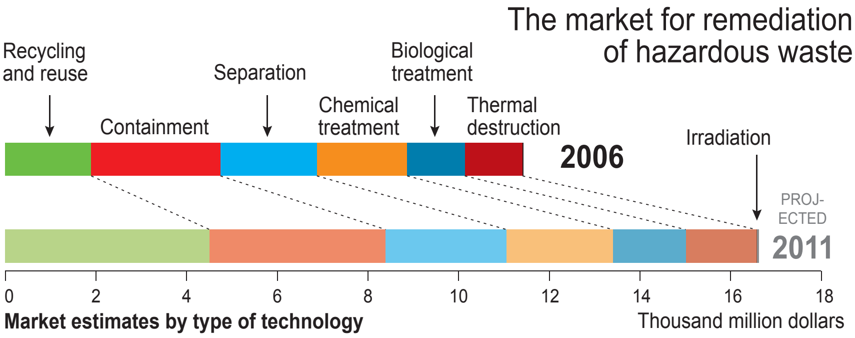
Profit is obviously only possible if revenue from waste exceeds the cost of its handling. The waste market is therefore highly dependent on the price of raw materials and of energy. High prices for primary raw materials increase the revenue that can be expected from selling the valued fraction extracted from waste. With metals at the top of the commodity market (in terms of price per volume unit), demand for waste containing metallic elements is extremely high. In several regions the consumption of metals often exceeds the volume of extracted mineral ore. Scrap metals, cheaper than the primary material, can therefore constitute the main supply source for whole countries or industrial sectors.[10] Among scrap metals, precious metals present in small amounts in electronic devices and used-vehicle parts, have the highest economic value, and are therefore most attractive. In terms of volume, however, the top scrap metals are still steel, aluminium, copper, zinc



Waste or not waste

Discussing the status of "waste"

The European Commission is working on regulations for the status of secondary raw materials, and in particular the conditions under which some of them can be lifted out of the "waste" category after proper recovery (and thus exempted from waste regulations).



The market for remediation of hazardous waste

Source: BCC Research Market Forecasting, 2006.

Please note that the 2011 figures were estimated in 2006.

and iron, used in ships, cars and various types of infrastructure.

The second condition for profitability is the presence of state regulations. Through taxes or subsidies, states can improve the revenue of waste-market actors or, alternatively, reduce their costs. By introducing waste management standards or guidelines, or favouring similar private initiatives, states can also force waste producers to turn to specific economic sectors for the disposal or the recovery of their wastes complying with specific environmental or social criteria. This entails unavoidable costs for the producer – such as disposal fees – but secures revenue for the actors concerned. The remediation industry, for instance, depends entirely on the regulatory obligation for producers of hazardous or other types of waste to dispose of it in an appropriate way.

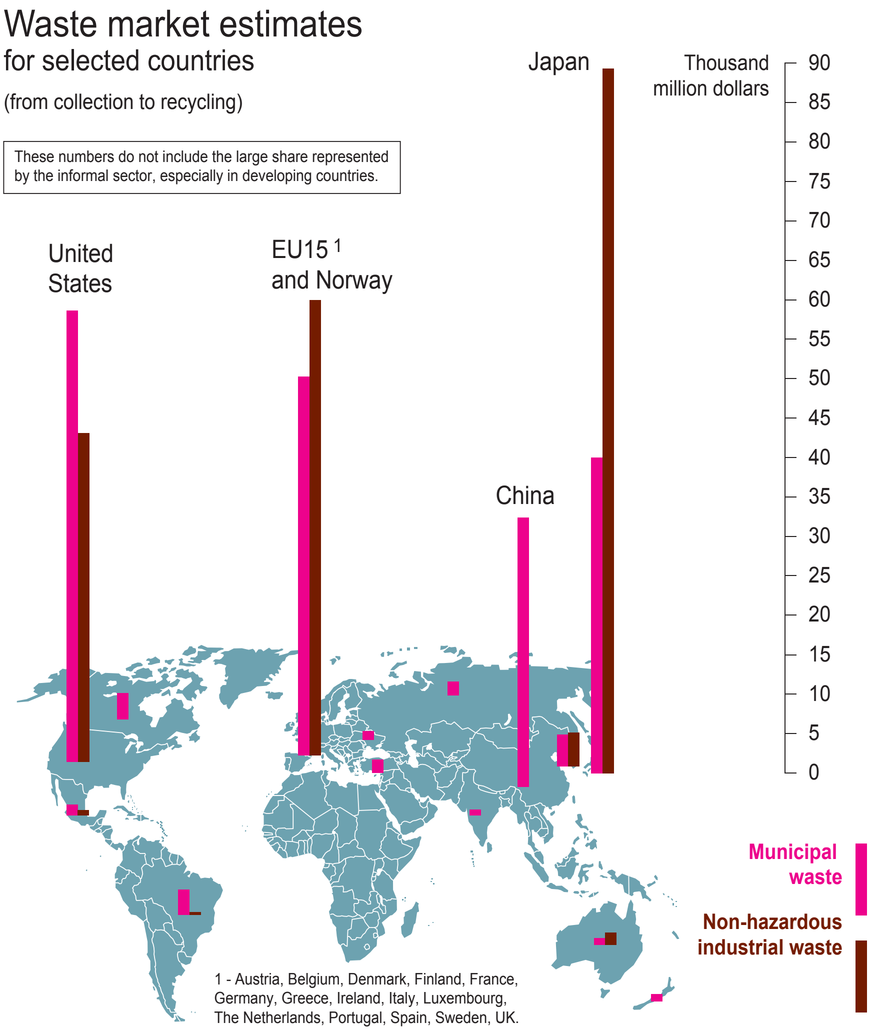
Emerging sectors such as biogas production and composting of biodegradable waste illustrate the vital necessity for state support for such projects, which may not be economically viable without appropriate regulations and incentives. Raising public awareness and providing adequate logistics and infrastructure are also important levers for action in the hands of public authorities.

Conversely, the absence of strict standards, or the failure to respect existing rules, allows actors on the waste market to avoid certain costs and thus increase their final profit. Such socially irresponsible behaviour is criminal when adopted as a deliberate ploy in a regulated context. However developing countries have few environmental regulations and implementing the existing framework is often hampered by corruption and lack of enforcement capacity, knowledge and technology.

Recycling – finding the right scale

Local, environmentally sound recycling has clear advantages: less transport, less primary raw materials extraction and associated environmental impacts. Appropriate facilities, however, are not available everywhere due to the substantial financial resources required (mainly technology and energy costs). In addition local businesses may not have a use for locally available scrap materials. Trading recyclables at a larger scale consequently seems necessary.

But for the recycling industry international trade, bringing prices down and opening up competition, means pressure on profit margins, with adverse effects on working conditions and the environment in places where regulations are weak or non-existent. Ultimately the increasing size and complexity of the recyclables market means the valuable benefits of international trade are highly dependent on successful monitoring and control of shipments, bringing scrap materials to the appropriate waste management facilities.



Waste market estimates for selected countries

(from collection to recycling)

1 - Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, The Netherlands, Portugal, Spain, Sweden, UK.

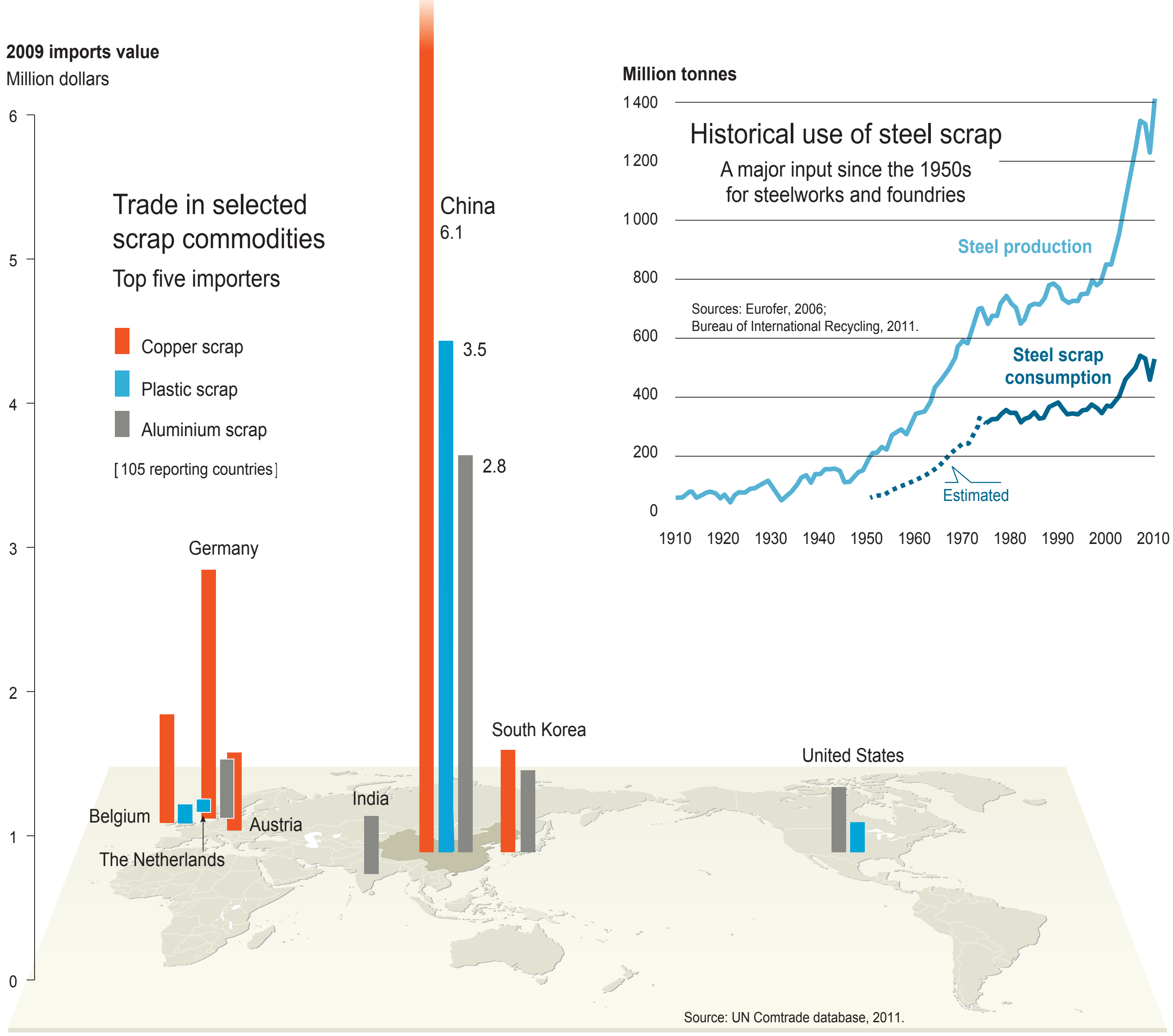
Source: Philippe Chalmin, Catherine Gaillochet, *Du rare à l'infini. Panorama mondial des déchets 2009.*

VITAL SCRAP

Scrap-metal recycling is booming. In 2008 approximately 71 million tonnes of ferrous waste and scrap were traded globally, with a value close to US$50 000 million.

Recycling metals is very advantageous both in terms of material and energy consumption. Depending on the process, steel can contain between 25 per cent and 100 per cent of recovered steel. Scrap is easily collected and sorted, and can be reused, most of the time with limited material property loss. The amount of energy required by recycling processes is generally much lower than for refining metal from ore – up to 95 per cent less energy for aluminium, and 75 per cent for iron and steel, according to some studies.

For several countries, especially where natural resources are scarce, this market represents a vital source for national supply. Cheaper than ore, recycled metal from the ship recycling industry accounts for 50 per cent of national steel production in Bangladesh, for instance, one of the three major actors of the international recycling market for ocean-going vessels (with Pakistan and India). Iron or steel make up 80-90 per cent of a ship (as a percentage of the empty vessel's weight), representing a valuable source of scrap steel for construction, for example. The collateral damage associated with recovery operations is nevertheless significant. Metal scrap is not generally hazardous in itself, but contamination with other hazardous substances is a recurrent problem. Recycling operations themselves often have dramatically negative impacts on workers and the environment due to the lack of appropriate health, safety and environmental standards. Ships sent for scrap contain a list of substances which make ship breaking sites highly polluted and dangerous, contaminated with used oil, asbestos cladding, flame retardants, toxic paints, heavy metals, amongst others. Official reports estimate that demand for scrap metal is not going to fall in the near future; on the contrary economic downturns tend to bring even more ships to breaking yards as owners seek to dispose of 'unproductive assets' quickly. If international regulations (such as those presented in the final chapter) are not properly enforced and as long as prevailing practices at ship breaking sites remain unchanged, hazardous substances will continue to accumulate, causing fatalities and injuries.


Trade in selected scrap commodities

Top five importers

[105 reporting countries]

Source: UN Comtrade database, 2011.

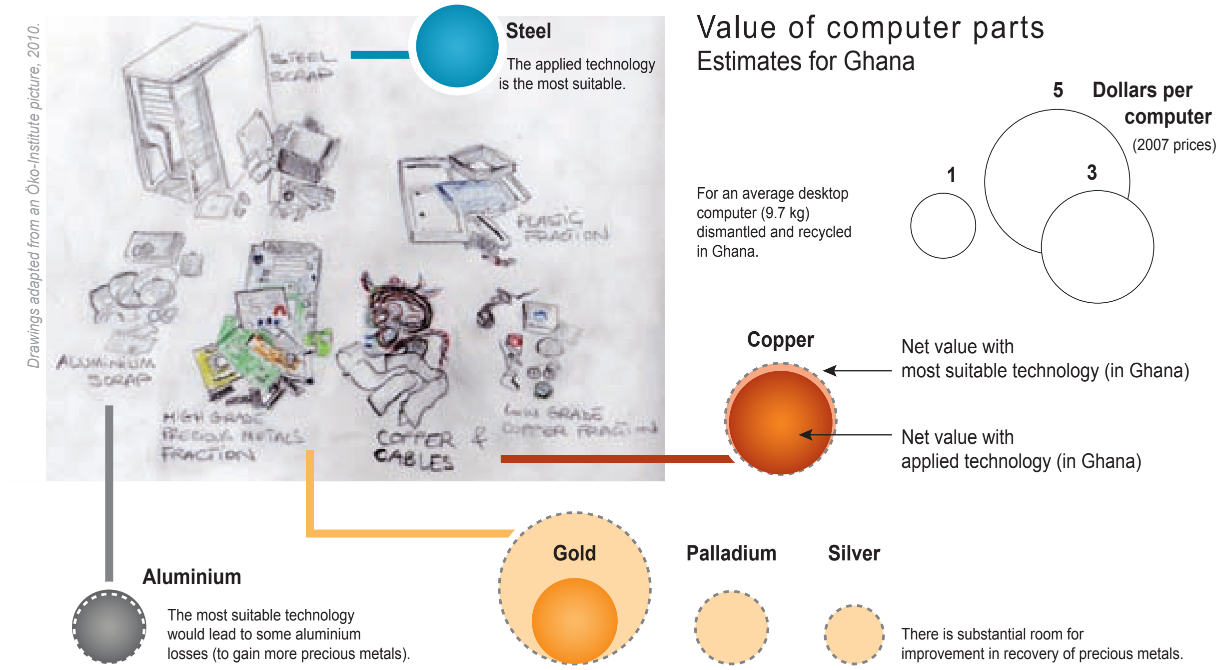
Historical use of steel scrap

A major input since the 1950s for steelworks and foundries

Sources: Eurofer, 2006; Bureau of International Recycling, 2011.

Value of computer parts

Estimates for Ghana



Drawings adapted from an Öko-Institute picture, 2010.

Sources: Gmünder, 2007; USGS, 2009; CSR, 2009 compiled by Siddharth Prakash and Andreas Manhart in *Socio-economic assessment and feasibility study on sustainable e-waste management in Ghana*, Öko-Institut e.V., 2010.

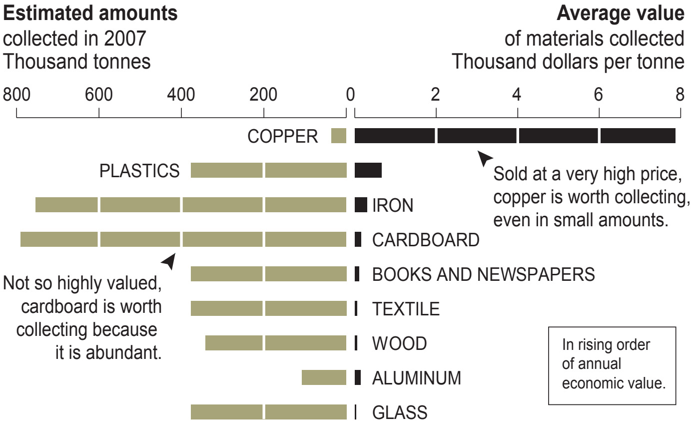
Waste picking, or scavenging, is a common income-generating activity for over 15 million people worldwide. Almost all of them live in developing countries where a varying share of municipal waste is not collected through formal channels. In these countries one to two per cent of the urban population is involved in recycling urban materials, with an economic impact estimated at several hundred million dollars. With incomes potentially higher than in the formal sector, incentives for scavenging are high, despite the heavy risks for workers' health and the environment. These conditions attract the most vulnerable sections of the population (migrants, unemployed, widows, children, elderly, disabled). In Brazil, for instance, the formal recycling industry itself relies on waste pickers, or catadores, who recover up to 90 per cent of recycled materials. In the Philippines 90 per cent of national lead consumption in 1999 was covered by recycling of used lead acid batteries (ULAB), of which 35 per cent was extracted from imported batteries. At the time the informal sector accounted for 30 per cent of this secondary lead production.

In urban environments where public waste services are deficient or non-existent, this informal recycling – often highly organized – provides a cheap and abundant workforce, as well as contributing to the supply of materials, to waste collection and recovery, which is far from negligible. Considering sanitary and environmental factors, as well as economic and social aspects, regulating this sector poses a major challenge for many cities; but examples exist of policies to capitalize on this contribution while improving working conditions (Colombia, Argentina, Brazil).

Such improvements yield multiple benefits. Inappropriate handling methods damage public health and the environment. But there may be adverse financial impacts too, with a valuable share of raw materials being lost or degraded in the process. Establishing basic social and safety standards, can improve both the quantity and quality of output, and working conditions.

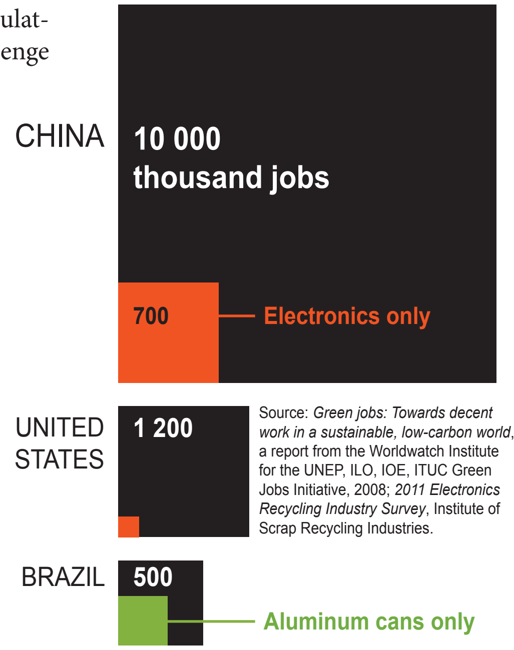
Beijing waste pickers

Source: Zhou Yan-fang et al., *Estimation of Economic Value of Recyclables Collected by Waste Pickers and Collectors and Suggestions for Their Management in Beijing*, 2010 International Conference on E-Business and E-Government.



Jobs in recycling

Estimates for selected countries



Source: *Green jobs: Towards decent work in a sustainable, low-carbon world*, a report from the Worldwatch Institute for the UNEP, ILO, IOE, ITUC Green Jobs Initiative, 2008; *2011 Electronics Recycling Industry Survey*, Institute of Scrap Recycling Industries.

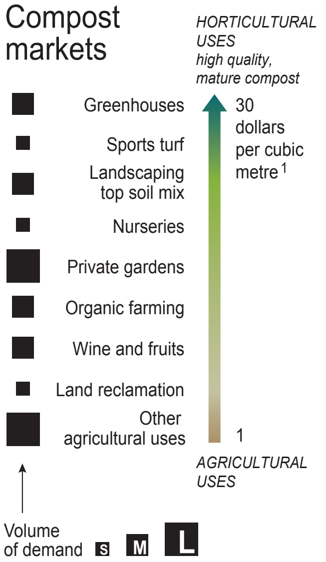
BIOGAS AND COMPOST

Organic or fermentable waste forms the largest fraction of municipal waste in most countries worldwide. From the 20-40 per cent range in high-revenue countries, the proportion rises to 50-80 per cent in developing countries. If paper and other biodegradable waste is also taken into consideration, this proportion can exceed two-thirds of urban waste.

This gives some idea of the importance of sorting and recovering compostable wastes. Composting, bio-methanization and similar processes can reduce not only the volume of waste going to landfill, but also provide cheap local fertilizing products for agriculture. Moreover, with appropriate means and infrastructure, energy or heat can be recovered from such fermentation processes; greenhouse gas emissions linked to incineration or normal degradation processes can also be reduced, as can air, soil and water pollution linked to leaching or other gas emissions.

Methane, for instance, is the main by-product of the biodegradation of organic material such as food waste, animal manure or waste from the paper or food industry. Major sources also include municipal waste landfills, wastewater treatment plants (sewage sludge) and agriculture (rice fields). Methane gas can often be collected and harnessed to produce heat, electricity or both (cogeneration) through the process of methanization of biomass. The local benefits are numerous – industrial and household energy, or heating supplies for example. The emissions avoided in this way can have a significant impact on climate change, considering the related reduction in fossil-fuel consumption and the fact that methane's global-warming potential is 21 times higher than carbon dioxide.

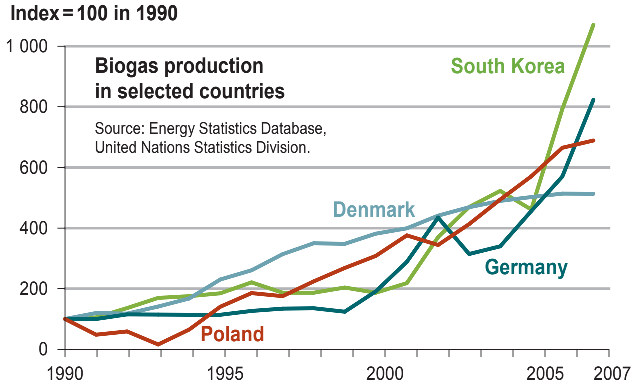
The issue of land-use competition between food crops and crops being grown especially for methanization (maize in Germany) remains contro-



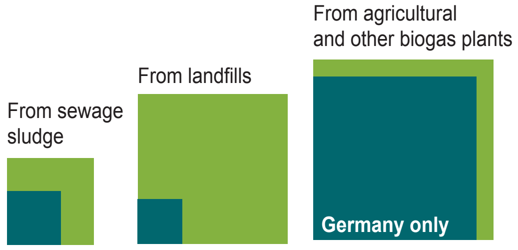
1 - 2000 price estimates for Europe.

Source: Modified from Amlinger, 2000 cited in *Economic Analysis of Options for Managing Biodegradable Municipal Waste*, a report by Eunomia for the European Commission, 2001.

Biogas: electricity, heat (and waste reduction)

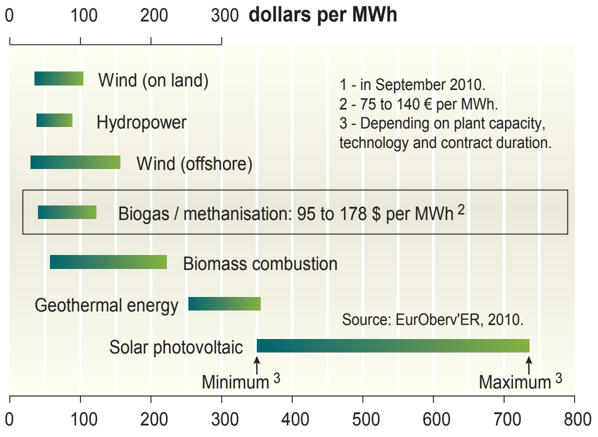


Primary energy produced from biogas in the European Union in 2009



Source: Biogas barometer, Eurobserv'ER, November 2010.

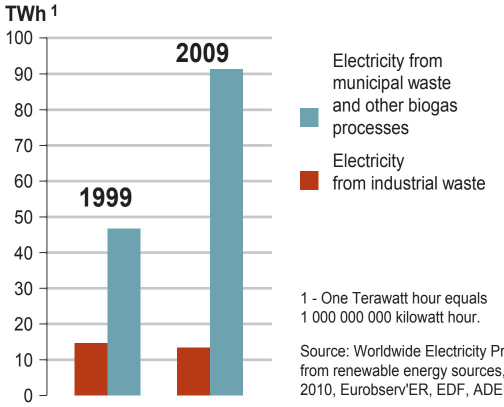
French regulation prices for electricity by source [1]



1 - in September 2010.
2 - 75 to 140 € per MWh.
3 - Depending on plant capacity, technology and contract duration.

Source: EurOberv'ER, 2010.

World electricity from waste



1 - One Terawatt hour equals 1 000 000 000 kilowatt hour.

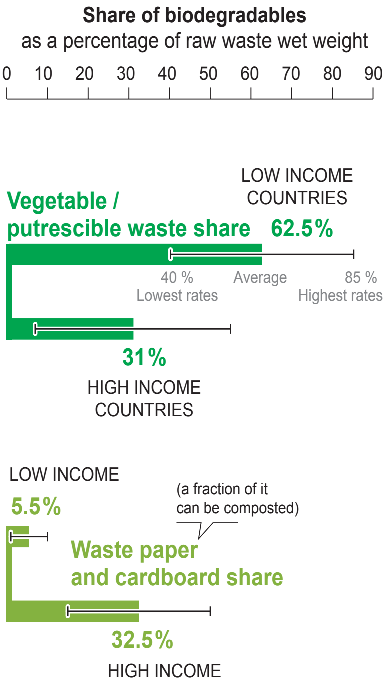
Source: Worldwide Electricity Production from renewable energy sources, Edition 2010, Eurobserv'ER, EDF, ADEME.

versial. Many European countries prefer to convert existing waste feedstock. Here too, the investment in appropriate solid-waste management policies and facilities is significant, often beyond the means of many municipalities in lower-income countries.

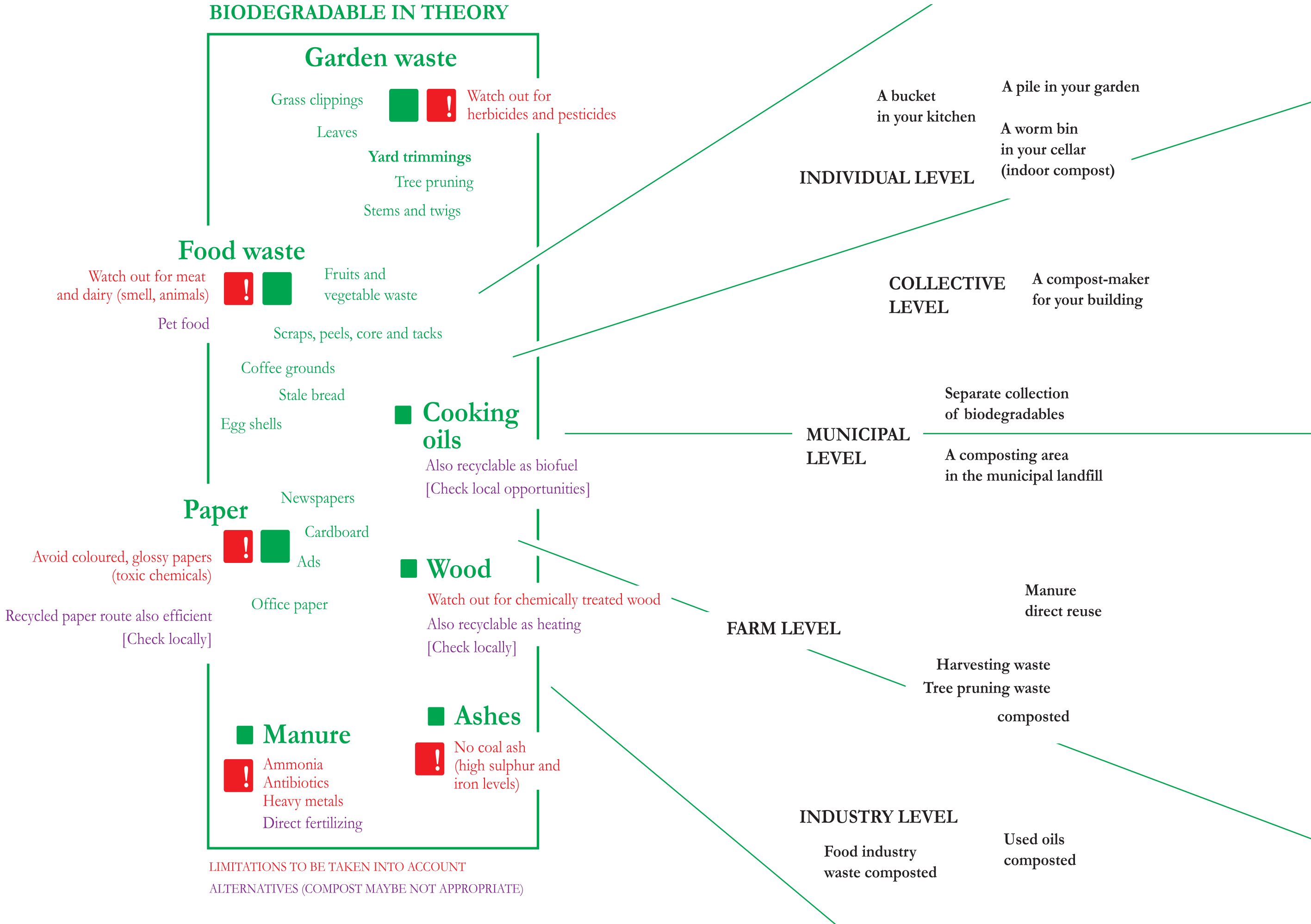
Organic waste encompasses all types of materials derived from living organisms (plants or animals);[11] as for compostable and biodegradable waste, the terms indicate particular properties of the materials. Composting represents 'the controlled biological decomposition of organic material' under specific thermal and aeration conditions. A compostable product will completely break down into carbon dioxide, water and sometimes humus, under specific conditions. On the other hand, biodegradable products only partially break down; these products often leave traces of material in the environment, may release toxics and cannot be used by the earth's ecosystem as a resource.

All sorts of organic waste can enter the composting process, even used oil from the oil industry. The operation is technical, demanding a balance between nitrogen and carbon inputs ('green' and 'brown' materials), aeration (stirring), optimal moisture, and stable temperature. The outputs, concentrated liquid (leachate) and gas emissions, can have serious impacts if not managed appropriately. Studies now show that biodegradable waste can contain arsenic (animal growth promoters, banned in the EU and New Zealand), feed additives, antibiotics (in manure: in 2007, 70 per cent of all antimicrobials in US were used for livestock production) and heavy metals. All this remains in composting outputs. This serious obstacle highlights the prominent concerns related to our feedstock and livestock production. Input in composting processes should be controlled. But the number-one priority is still for measures and changes to be deployed higher up the chain. Only in this way will we be able to reduce the hazards and boost the potential of composting biodegradable waste. However many countries still lack the technology and funding to improve awareness, waste collection and treatment methods.

Compostable wealth:
a large share
[especially in poor countries]



Source: Sandra Cointreau, *Occupational and Environmental Health Issues of Solid Waste Management. Special Emphasis on Middle- and Lower-Income Countries*, World Bank, Urban Papers, July 2006.



WASTE COSTS

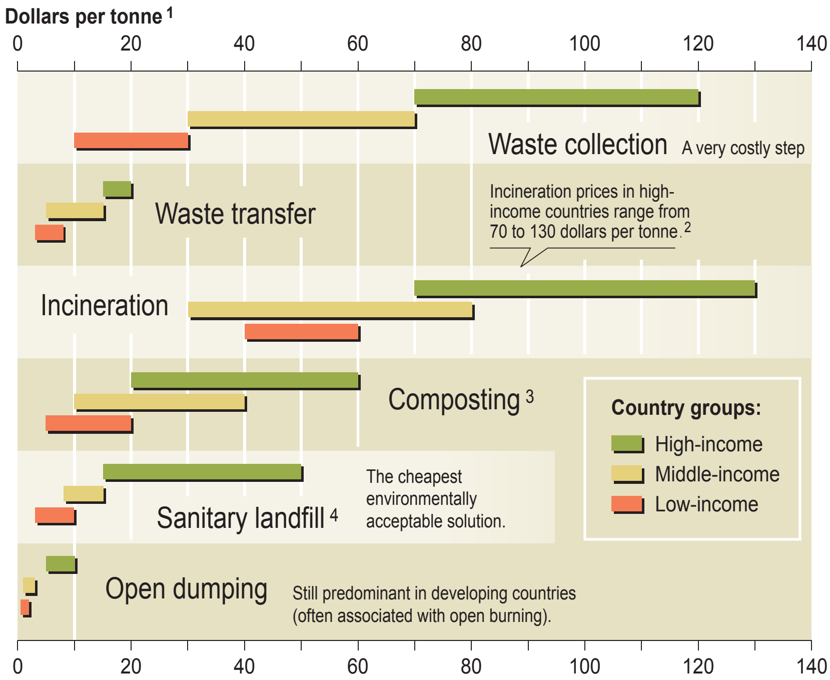
DIRECT COSTS

The brief description of the profitability of waste markets in the previous chapter is based on a simple cost-benefit analysis: economic profit can be derived from waste when revenue exceeds costs. But such estimates tend to overlook various indirect costs which, though often not included in producers' sums, fall to society as financial costs or negative impacts on health and the environment. Such negative externalities are particularly difficult to identify and estimate.

The growing body of waste regulations puts more and more pressure on waste producers. The purpose is usually to encourage the proper disposal of wastes and ultimately a cut in output. Where enforcement is successful, the frequent use of economic instruments to foster changes in practices often means additional costs for waste producers, compensated in a number of cases by the industry's growing demand for raw materials (primary and secondary) and potentially by lower waste-management costs as the sector develops. All economic actors generating waste consequently need to estimate waste management costs and incorporate them in their financial planning.

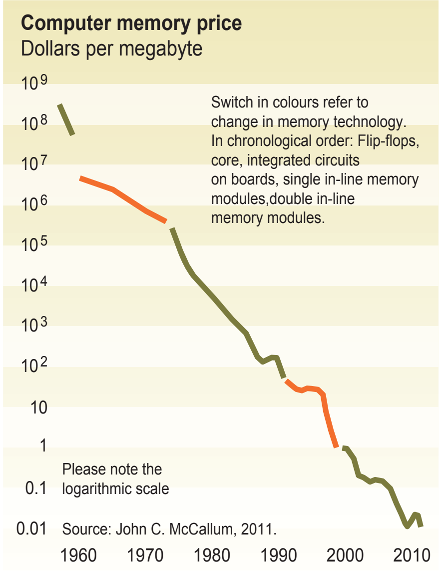
In the case of the nuclear power industry, the task is extremely complex and controversial, with regards to the interests and risks at stake. The whole process of nuclear decommissioning, among others, represents an extraordinary financial burden that is difficult to estimate. The problems caused by radioactive waste are much larger than the management of spent fuel or the amount of radioactive medical and industrial waste. In the next

Solid waste management costs



1 - In order to capture economies-of-scale, the study considers cities over 500 000 people or producing more than 250 tonnes of waste a day. 2 - The higher range of costs for incineration is for systems with modern air pollution control. 3 -The higher range of costs for composting is for systems with mechanized classification, pulverization and forced aeration; while the lower range of costs is for systems with hand sorting, trommel screening and simple open air windrows. 4 - The higher range of costs for sanitary landfill is for systems with plastic membranes and full leachate collection and treatment systems; while the lower range of costs is for natural attenuation landfills where site conditions do not require leachate management. Careful site selection can substantially reduce landfill costs.

Source: Sandra Cointreau, *Occupational and Environmental Health Issues of Solid Waste Management. Special Emphasis on Middle- and Lower-Income Countries*, World Bank, Urban papers, July 2006.



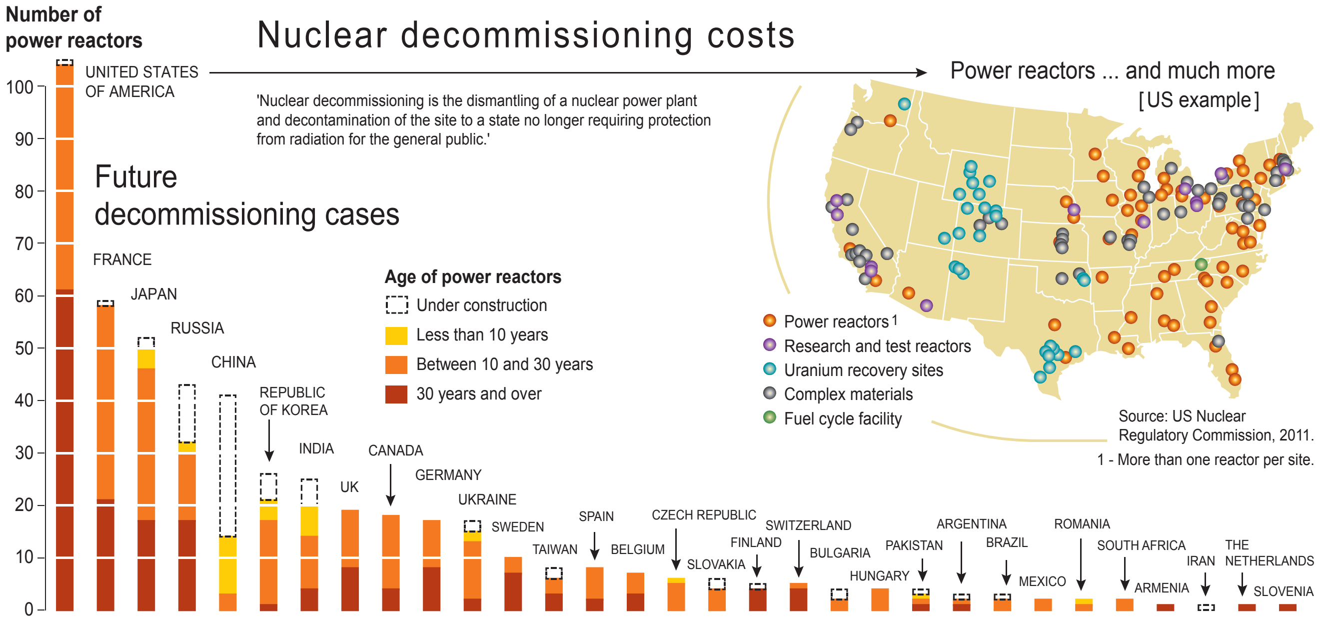
Source: John C. McCallum, 2011.

What is the right price?

You would think the price you pay for a product includes direct manufacturing costs, such as materials and labour, and indirect costs such as factory lighting, rent, administrative personnel and depreciation. Obviously the price should also cover an appropriate share of expenditure on research and development, marketing, distribution and taxes. Economies of scale may then reduce some of these costs. Waste management costs may be included, among others, in production costs and tax.

But for complex reasons related to the market and competition, today's prices appear increasingly disconnected from such concrete values. This leaves us, as consumers, wondering what the proper price for a specific item should be. Increasingly unable to appreciate the value of goods and distinguish it from their price, we tend to see the act of buying and throwing away as trivial, effortless actions disconnected from their physical consequences. An extreme example is the price of electronics, as illustrated by the spectacular drop in the cost of computer memory in the past five decades.

Nuclear decommissioning costs



'Nuclear decommissioning is the dismantling of a nuclear power plant and decontamination of the site to a state no longer requiring protection from radiation for the general public.'

Source: US Nuclear Regulatory Commission, 2011.

1 - More than one reactor per site.

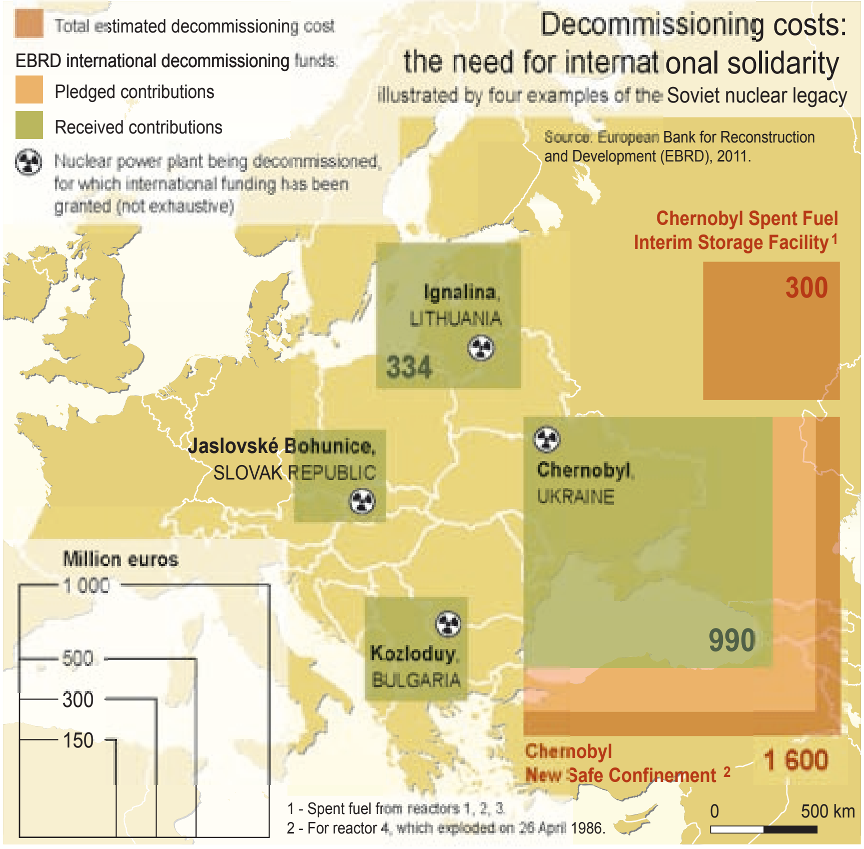
Sources: *Power Reactor Information System database*, International Atomic Energy Agency, 2011; *Nuclear Power Plant Database System*, Jožef Stefan Institute, 2001.

few decades, the majority of facilities worldwide are going to reach the end of their useful lives, for technical and/or socio-political reasons. Decommissioning a nuclear plant, which not only includes dismantling the reactor itself but also decontaminating the site, produces several types of waste, each of which needs special processing. For example, the Swiss authorities estimate that dismantling their five nuclear power plants will generate about 100 000 m^3 of radioactive waste. The bulk consists of scrap metals and other materials which can be recycled or disposed of with conventional waste. On the other hand, the spent fuel and the rest of the contaminated materials must be sorted and shipped to radioactive-waste disposal facilities, or storage when such facilities are not yet available.[12]

Three simple terms summarize all the factors which make these cost estimates highly sensitive: knowledge, time and finance. At present only about 10 per cent of all shut-down plants have been fully decommissioned. But their technology and power rating were not the same as recent facilities, and the format, content and practice of such cost estimates vary a great deal from one case to the next; the experience gathered will therefore be of limited use for future operations. Depending on decommissioning strategy, the time required for such operations may last from just a few years up to several decades, or more. Time also matters with regard to the long-term toxicity of radioactive waste (it takes 24 000 years for half the Plutonium-239 atoms to decay). Accounting for these numbers in any financial forecast is particularly challenging. But what is most striking is that the same actors in the nuclear industry provide all the cost estimates, crucial expertise and funds. This well-known conflict of interest raises legitimate concerns about the reliability of calculations and the possible internalization of environmental costs. Final numbers are not only difficult to provide, but difficult to trust.

Decommissioning costs: the need for international solidarity

illustrated by four examples of the Soviet nuclear legacy

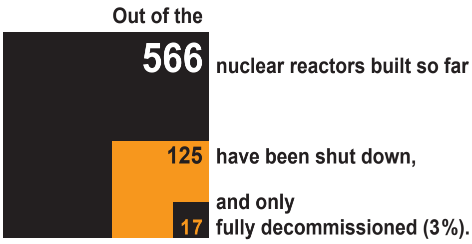


Source: European Bank for Reconstruction and Development (EBRD), 2011.

1 - Spent fuel from reactors 1, 2, 3.

2 - For reactor 4, which exploded on 26 April 1986.

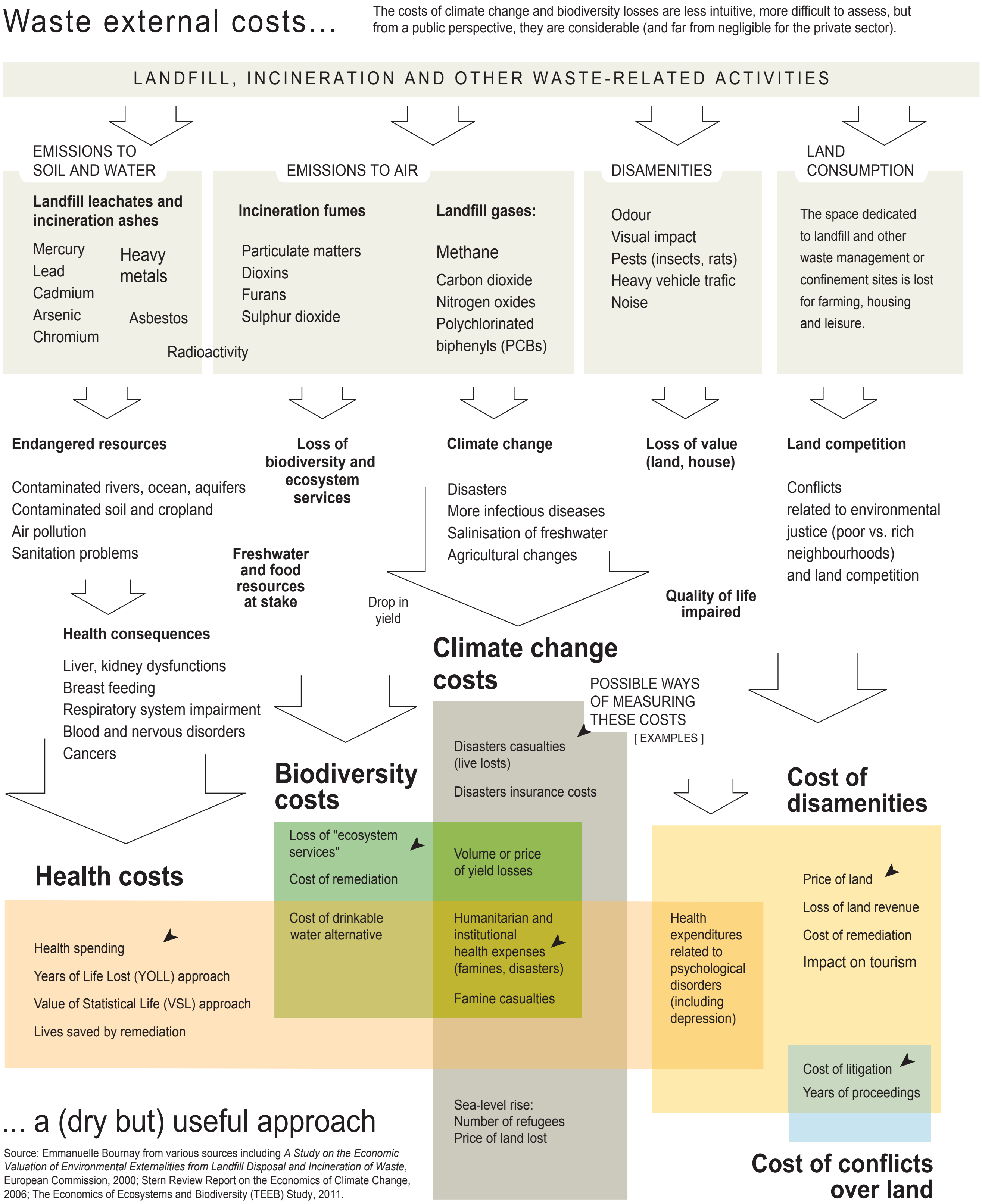
Nuclear decommissioning: so little experience



Source: Nuclear Training Centre (ICJT), Jožef Stefan Institute, Slovenia.

GHOST COSTS I: THE ENVIRONMENT

Whereas some local, easily identifiable pollution caused by inappropriate waste management may appear in economic calculations, no account is currently made for most impacts on the environment. Much as climate change, damage to ecosystem services or biodiversity is often difficult to trace to its source.



Waste external costs...

The costs of climate change and biodiversity losses are less intuitive, more difficult to assess, but from a public perspective, they are considerable (and far from negligible for the private sector).

LANDFILL, INCINERATION AND OTHER WASTE-RELATED ACTIVITIES

EMISSIONS TO SOIL AND WATER

Landfill leachates and incineration ashes

Mercury
Lead
Cadmium
Arsenic
Chromium
Heavy metals
Asbestos
Radioactivity

EMISSIONS TO AIR

Incineration fumes

Particulate matters
Dioxins
Furans
Sulphur dioxide

Landfill gases:

Methane
Carbon dioxide
Nitrogen oxides
Polychlorinated biphenyls (PCBs)

DISAMENITIES

Odour
Visual impact
Pests (insects, rats)
Heavy vehicle trafic
Noise

LAND CONSUMPTION

The space dedicated to landfill and other waste management or confinement sites is lost for farming, housing and leisure.

Endangered resources

Contaminated rivers, ocean, aquifers
Contaminated soil and cropland
Air pollution
Sanitation problems

Loss of biodiversity and ecosystem services

Climate change

Disasters
More infectious diseases
Salinisation of freshwater
Agricultural changes

Loss of value (land, house)

Land competition

Conflicts related to environmental justice (poor vs. rich neighbourhoods) and land competition

Health consequences

Liver, kidney dysfunctions
Breast feeding
Respiratory system impairment
Blood and nervous disorders
Cancers

Freshwater and food resources at stake

Drop in yield

Quality of life impaired

Health costs

Biodiversity costs

Climate change costs

Cost of disamenities

Cost of conflicts over land

POSSIBLE WAYS OF MEASURING THESE COSTS
[EXAMPLES]

Health spending
Years of Life Lost (YOLL) approach
Value of Statistical Life (VSL) approach
Lives saved by remediation

Loss of "ecosystem services"
Cost of remediation
Cost of drinkable water alternative

Disasters casualties (live losts)
Disasters insurance costs
Volume or price of yield losses
Humanitarian and institutional health expenses (famines, disasters)
Famine casualties
Sea-level rise:
Number of refugees
Price of land lost

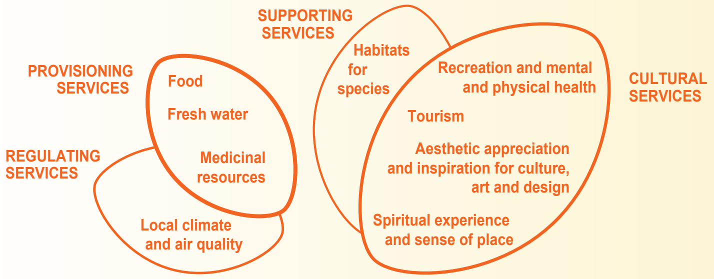
Health expenditures related to psychological disorders (including depression)

Price of land
Loss of land revenue
Cost of remediation
Impact on tourism

Cost of litigation
Years of proceedings

... a (dry but) useful approach

Source: Emmanuelle Bournay from various sources including *A Study on the Economic Valuation of Environmental Externalities from Landfill Disposal and Incineration of Waste*, European Commission, 2000; Stern Review Report on the Economics of Climate Change, 2006; The Economics of Ecosystems and Biodiversity (TEEB) Study, 2011.

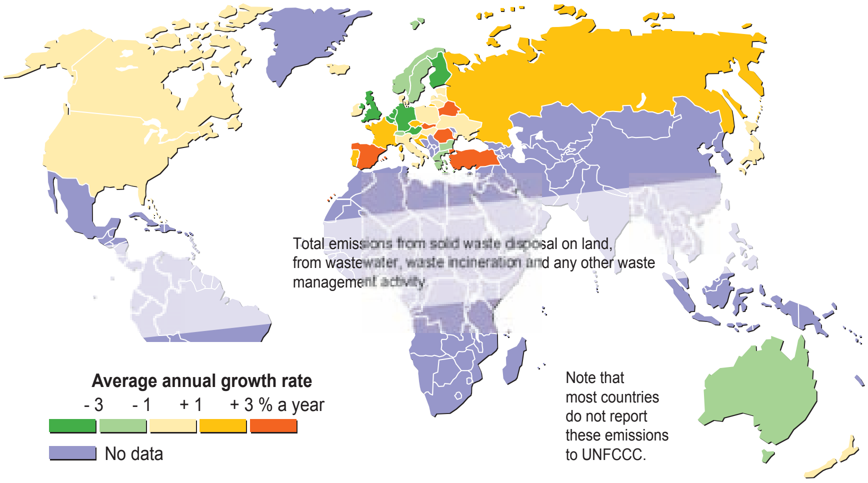


Ecosystem services potentially affected by [faulty] waste [management]

Source: The Economics of Ecosystems and Biodiversity (TEEB) Study, 2011.

Trends in greenhouse gas emissions from waste [1990-2009]

Source: United Nations Framework Convention on Climate Change, 2011.



Total emissions from solid waste disposal on land, from wastewater, waste incineration and any other waste management activity

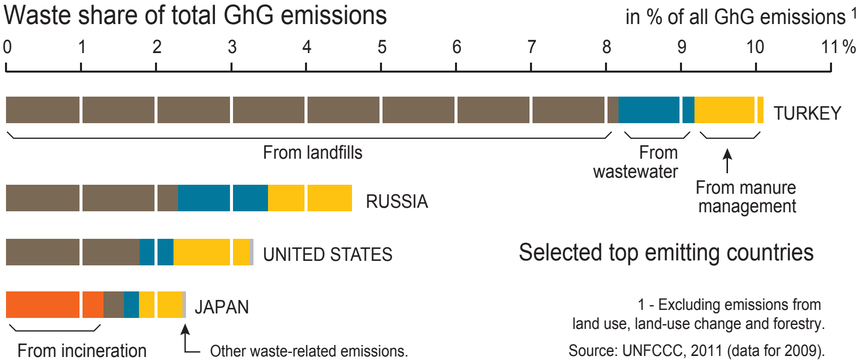
Note that most countries do not report these emissions to UNFCCC.

Recent economic studies show that the social consequences of such degradation fall most heavily on those who depend directly on these services for subsistence and income, the rural poor. It is indeed from sectors like agriculture, animal husbandry and informal forestry – activities constitutive of the 'GDP of the poor'- that 'much of the developing world's poor draw their livelihood and employment.'[13]

Building upon the example set by the Stern Review Report on the Economics of Climate Change (2006), the Economics of Ecosystems and Biodiversity (TEEB) study has attempted to quantify the effective costs of 'the loss of biodiversity and the associated decline in ecosystem services worldwide, and to compare them with the costs of effective conservation and sustainable use.' These studies and their wide impact have shown how effective it is to put numbers on environmental issues in order to prioritize such issues on the political agenda. Indeed, the results of the studies should provide the means to correct the price signals driving market actors today. The aim of internalizing negative externalities, already a longstanding approach, is to restore the balance in economic accounting and create the right incentives. For this we need to see the situation from a different perspective, based on the costs and benefits theoretically incurred by society and nature. With such an approach, health and remediation costs, loss of time and ecosystems can all be estimated in economic terms, even life thanks to the value of a statistical life (VSL) approach. The accuracy of calculations and of basic assumptions is clearly open to question, given the extreme difficulty of finding reliable data; and we are still a long way from solving the problem of identifying sources of pollution or damage in order to assign costs (polluter-pays principle). These approaches remain, however, a useful means of attracting the attention of economic actors who reason in terms of costs and benefits. In time such internalization may help change behavioural patterns and production methods. Their application to waste could in turn yield valuable outputs, providing estimates of the external costs involved in waste-management activities. But systematic use of these economic simplifications may dangerously distract us from addressing crucial social and ethical questions. A tool is a tool, and a model is never the real thing.

According to United Nations Environment Programme reports, waste management represents a relatively minor contribution to global greenhouse gas emissions – 3-5 per cent of total anthropogenic emissions in 2005. The major source of greenhouse gases in the waste sector is generally considered to be methane from landfill. However these estimates are hypothetical due, among others, to the large diversity of management techniques and the lack of reliable data for many regions. Moreover reports of the United Nations' Framework Convention on Climate Change (UNFCCC) account for emissions from waste under various categories, such as agriculture (especially manure). The global contribution of waste could therefore be much larger in fact. But environmentally sound waste management reduces emissions in all other economic sectors, through lower landfill emissions, improved material and energy recovery, waste prevention, and cuts in raw material extraction and manufacturing. Waste-related expenditure should consequently be included in global climate-change mitigation costs estimated, for instance, by the Stern Review, at about 1 per cent of Global GDP by 2050 in order to stabilize greenhouse gases levels at 550ppm CO_2 equivalent.

Waste share of total GhG emissions



Selected top emitting countries

1 - Excluding emissions from land use, land-use change and forestry.

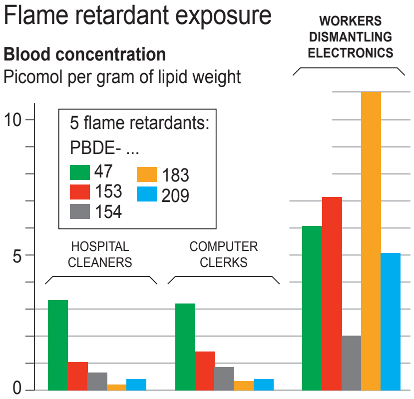
Source: UNFCCC, 2011 (data for 2009).

GHOST COSTS II: HEALTH

Cost-benefit analysis by economic actors rarely includes impacts on human health. Waste pickers or workers on many ship breaking sites often earn meagre wages at the expense of their own health. Numerous other industrial activities release hazardous substances into the environment (air, water, soil), including waste-related operations. Impacts on human health and environmental degradation go hand-in-hand, and both are direct consequences of this situation.

The generation and composition of waste are largely affected by a country's income, just as much as its level of industrialization. Unfortunately this holds true for waste-related health problems. Low-income countries produce less waste, but a smaller portion is collected too. Hazardous wastes are often mixed with municipal waste due to the lack of an alternative collection and disposal system, and the failure to fully enforce waste regulations where they do exist. In addition, protective measures for waste workers and nearby inhabitants, pollution control systems and risk mitigation measures are often insufficient in such countries. Waste management is there mostly dealt with by the informal sector, consisting of workers from vulnerable sections of the population who live and work on-site. The presence of hazardous (medical) waste and the mismanagement of other types of waste (burning electronic or electrical components to recover metals) can seriously impact a population's health and environment. Studies suggest that about 50-80 per cent of electronic waste produced in industrialized countries may be ending up in South-East Asia. Under the present circumstances it is extremely difficult for responsible consumers to ensure their waste is properly disposed of. It is hard for supervisory authorities to know the exact destination or real quality of these shipments.[14] The efforts and means to achieve such vital objectives are so huge that they have so far remained beyond our reach.

Flame retardant exposure



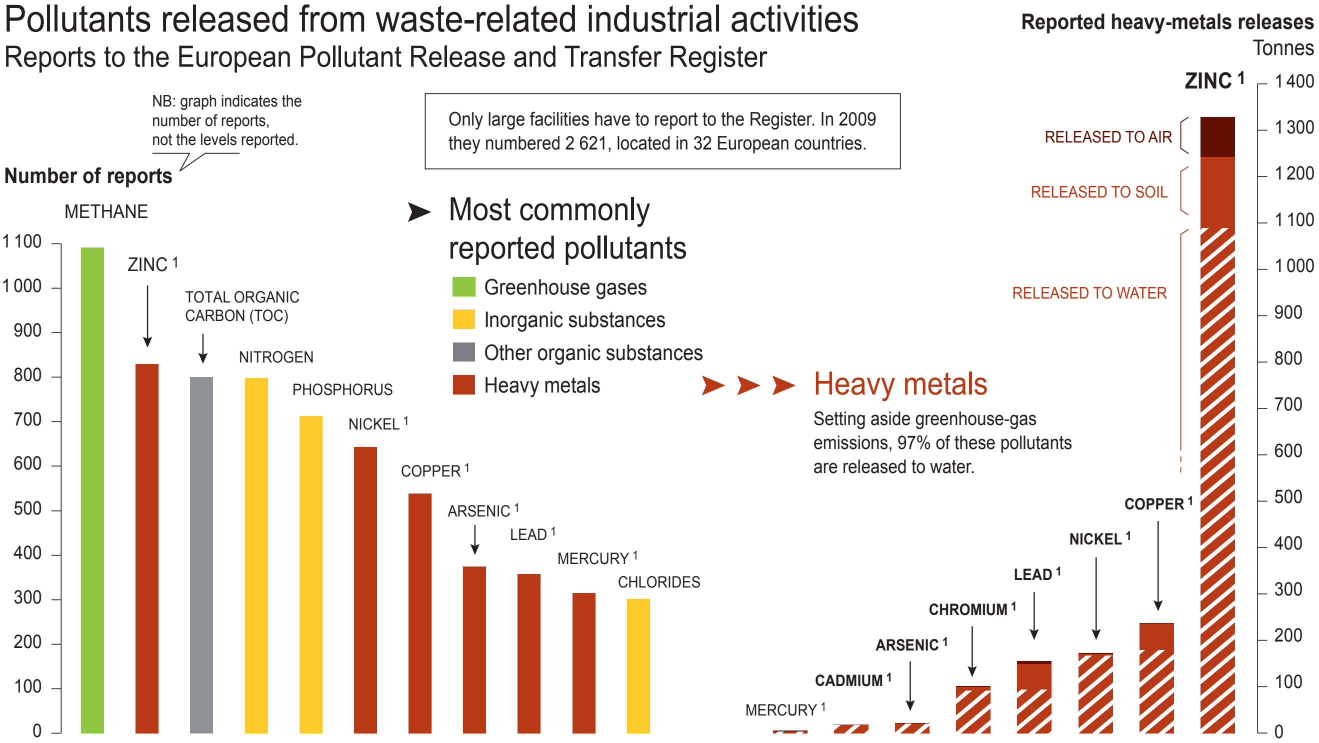
Source: Sjödin et al., *Flame retardant exposure: PBDE in blood from Swedish workers*, Environmental Health Perspectives, 1999.

Over and above landfill, concerns have emerged about livestock waste as a significant vector of diseases, in particular from animals to humans. Indeed, according to the Food and Agriculture Organization and the World Bank, 75 per cent of all human diseases emerging in the past decade have come from animals or products of animal origin (SARS, High Path Avian Influenza, Mad Cow, Lyme, Ebola).[15] The application of waste management measures directly on contact and exposure pathways can significantly reduce risks (more contained waste technologies, contaminant-emissions reduction, improved working methods, use of protective clothing). Developing and developed countries face this ongoing challenge, but the latter suffer much less than the former, with better access to mitigating measures and resources.

Pollutants released from waste-related industrial activities

Reports to the European Pollutant Release and Transfer Register

Only large facilities have to report to the Register. In 2009 they numbered 2 621, located in 32 European countries.



Heavy metals

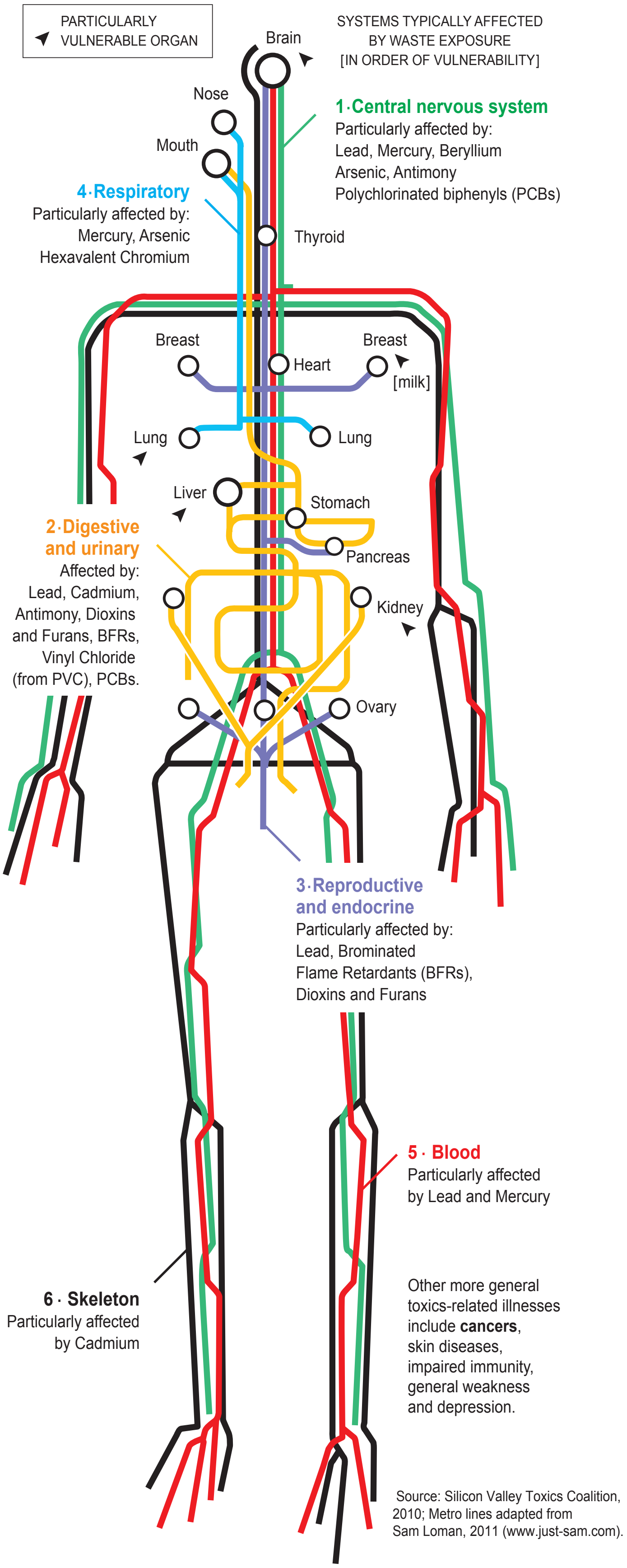
Setting aside greenhouse-gas emissions, 97% of these pollutants are released to water.

Source: E-PRTR, The European Pollutant Release and Transfer Register, 2011.

1 - and compounds.

Waste Body Burden

Health concerns affecting waste workers and people living close to landfills or incinerators



1·Central nervous system
Particularly affected by:
Lead, Mercury, Beryllium
Arsenic, Antimony
Polychlorinated biphenyls (PCBs)

4·Respiratory
Particularly affected by:
Mercury, Arsenic
Hexavalent Chromium

2·Digestive and urinary
Affected by:
Lead, Cadmium,
Antimony, Dioxins
and Furans, BFRs,
Vinyl Chloride
(from PVC), PCBs.

3·Reproductive and endocrine
Particularly affected by:
Lead, Brominated
Flame Retardants (BFRs),
Dioxins and Furans

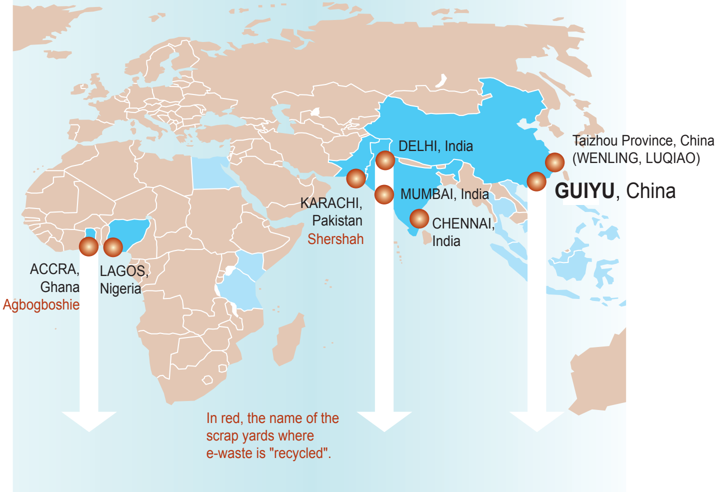
5 · Blood
Particularly affected
by Lead and Mercury

6 · Skeleton
Particularly affected
by Cadmium

Other more general toxics-related illnesses include **cancers**, skin diseases, impaired immunity, general weakness and depression.

Source: Silicon Valley Toxics Coalition, 2010; Metro lines adapted from Sam Loman, 2011 (www.just-sam.com).

Notorious World WEEE[1] dumps



- 🟦 E-waste destination countries
- 🟦 Suspected e-waste destination countries

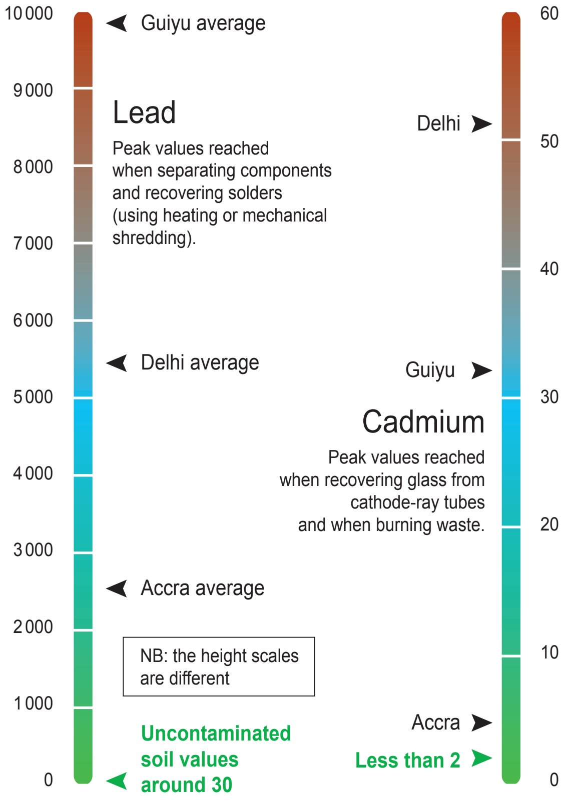
[1] - Waste electrical and electronic equipment

Associated heavy metals levels

Sources: Greenpeace, *Recycling of Electronic Wastes in China and India: Workplace and Environmental Contamination*, 2005; Greenpeace, *Chemical Contamination at e-waste recycling and disposal sites in Accra and Koforidua*, Ghana, 2008.

Dust, soil or sediments (direct residues like ashes and wastewater excluded) sampled in and around the studied e-waste scrap yards and workshops.

Milligram of specific heavy metal per kilogram of dry weight in samples



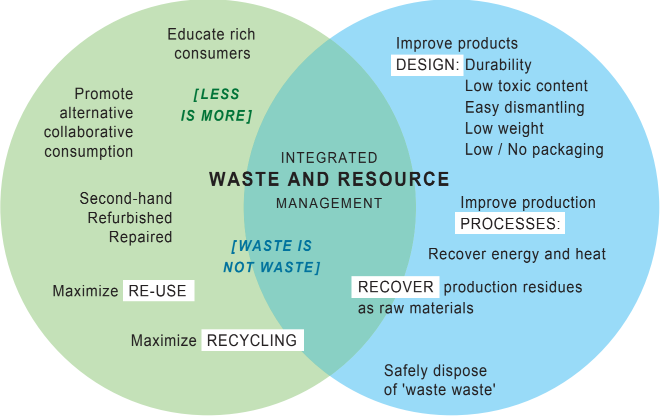
Lead
Peak values reached when separating components and recovering solders (using heating or mechanical shredding).

Cadmium
Peak values reached when recovering glass from cathode-ray tubes and when burning waste.

NB: the height scales are different

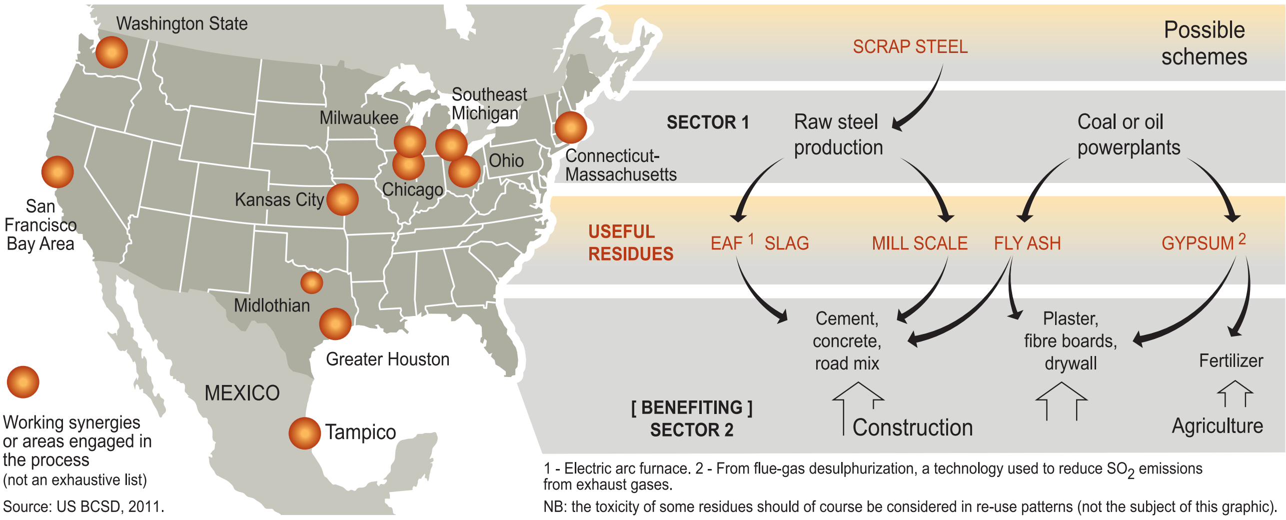
CLOSING THE LOOP

The ultimate aim is to close the loop of the economy, which means reducing as much as possible the economic system's inputs and outputs into and out of the natural substratum. In other words, we need to change the equation linking the global variables to the growing waste heap: rising population should not directly imply an equal rise in consumption and waste production, or greater pollution and resource depletion.



The first step is to transform our approach to human industry into 'integrated waste and resource management.' Durable goods, collaborative consumption (sharing goods), a functionality-based economy (buying a function or service, rather than goods)[16] are some of the theoretical strategies of this general decoupling of economic growth from waste production. But this goal can only be achieved if in turn consumers and producers accept their share of responsibility, or have the capacity to do so. Governments, in their capacity as major consumers and employers in most national markets, must set an example in their own operations (through internal waste prevention measures, energy consumption, mobility policies). In view of the enormous volume of goods and services at stake, governments' setting of minimum environmental standards for public spending (through effective and responsible green procurement policies) can act as a significant driving force for the market. Such massive flows can reduce the production costs of durable goods and services, and support specific actors or sectors of the economy which have integrated durability principles. States have both the capacity and the responsibility to preserve the common interest, which in this case means promoting a sustainable economic system. Big private companies, with sizes and influence over the economic system similar to States, share such responsibility, as expressed in their respective Corporate Social Responsibility policies. Implemented by significant economic actors, green or sustainable procurement strategies, public or private, have a serious impact on whole supply chains.

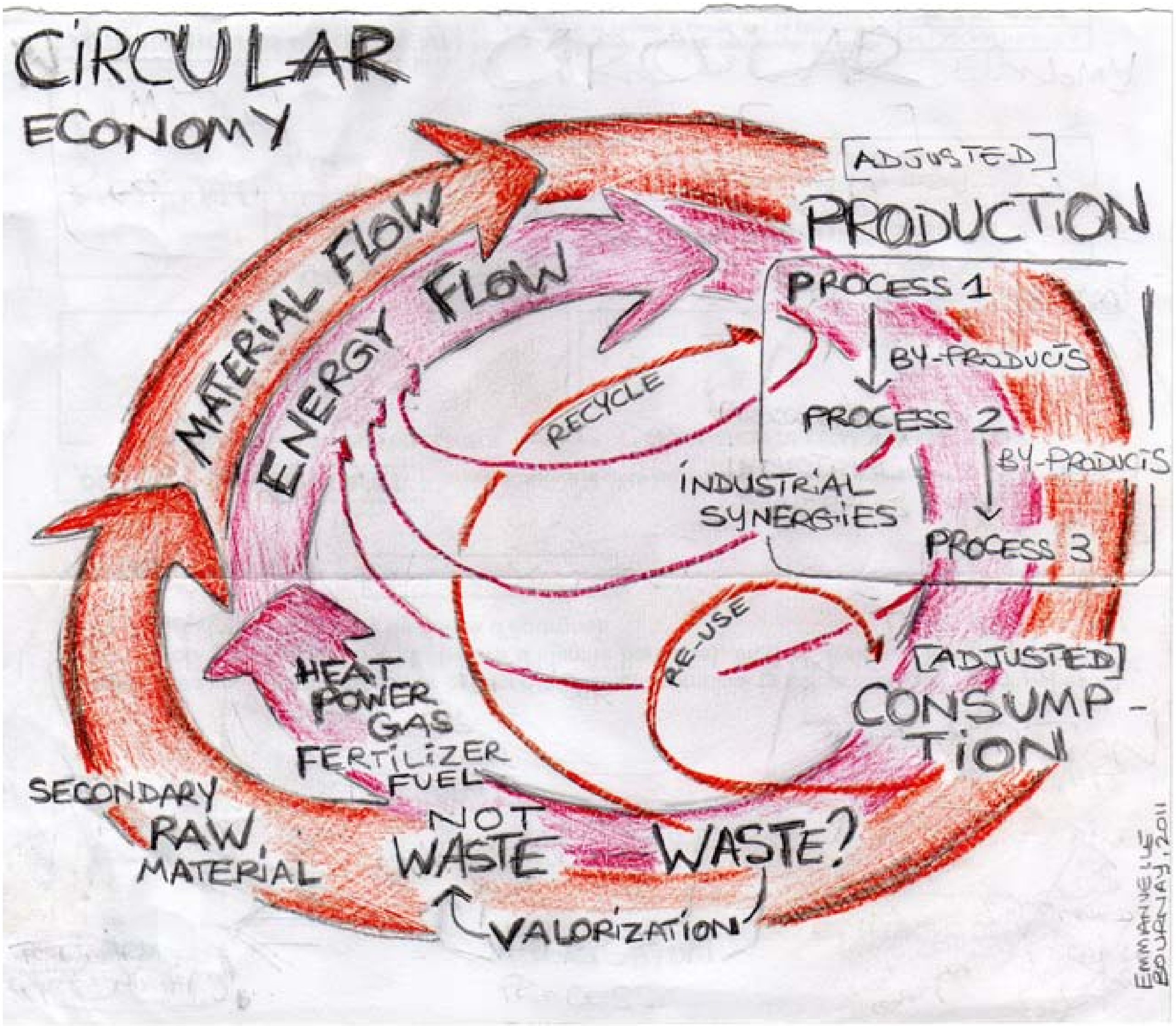
Industrial synergies: mobilizing business to foster re-use of residues in local industry



Source: US BCSD, 2011.

1 - Electric arc furnace. 2 - From flue-gas desulphurization, a technology used to reduce SO_2 emissions from exhaust gases.

NB: the toxicity of some residues should of course be considered in re-use patterns (not the subject of this graphic).



Industrial ecology

The 'industrial ecology' approach suggests a view of the industrial system as one type of human ecosystem in interaction with the biosphere. Like biological ecosystems, this particular type can be described in terms of flows and stocks of materials, energy and information. On this theoretical basis, a number of methodologies have been developed to help the decision-making process concerning the industrial system. Apart from the two most famous – life-cycle assessments (LCA) and material flow analysis (MFA)[17] – the principle of 'industrial synergies' (by-product synergies or industrial symbiosis) has had a significant impact on the planning of industrial sites, and planning in general. Inspired by biological synergies, this principle focuses on possible forms of interaction between various industrial activities or processes within the same plant. The aim is to reduce the overall material and energy consumption by considering all types of waste or by-products as a potential resource for another process. Heat discharged into the air by many industrial processes can, for example, serve to reduce the amount of heating energy needed by other processes. Two main obstacles still hamper development of the synergy principle. Firstly, industrial production covers a large diversity of material flows, with specific compounds and properties. Without particular attention to the design of processes, a majority of output or throughput flows (mostly heterogeneous) does not match the requirements for input (homogeneous). Moreover for synergy planning to work, industrial actors must have a detailed understanding of their production operations and, perhaps more problematic, they must be prepared to share it.

GREEN RULES FOR GREEN PRODUCTS

As one of the major sources of waste, industry should bear significant responsibility for the problem. It also holds the key to improvements through innovative solutions.

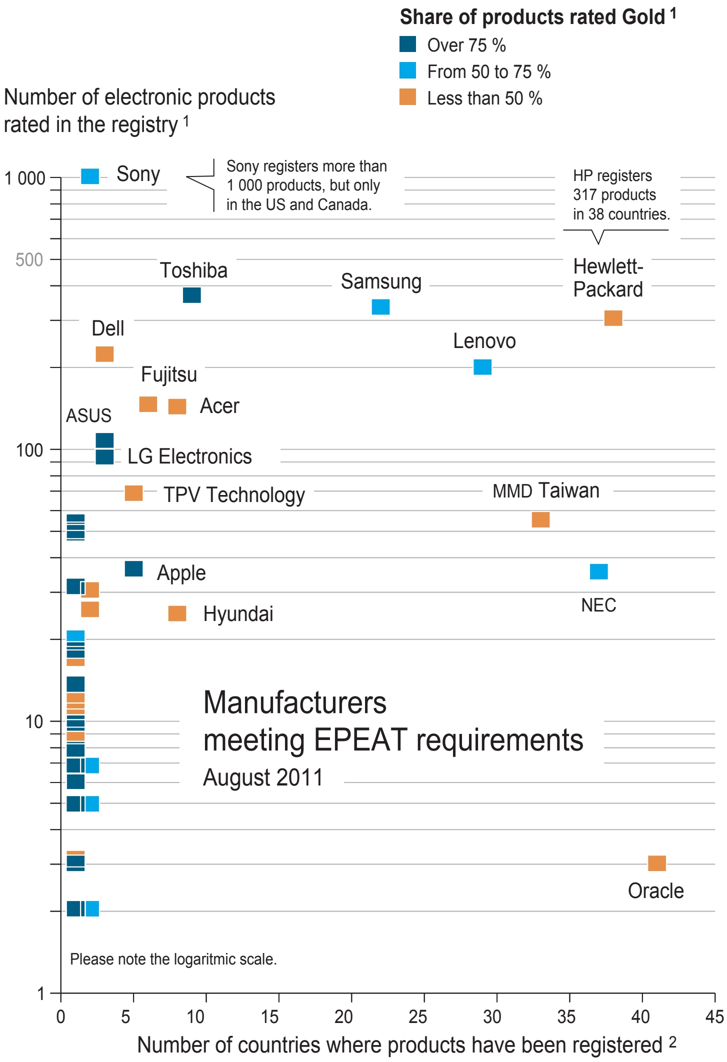
The waste market itself, much as any market, operates within a framework of regulations. Public authorities can influence it to meet the growing challenges of waste management, and thus help the industry shoulder its responsibility. The principle of Extended Producer Responsibility (EPR), for instance, is present in various environmental policies. Designating a large variety of instruments and methods, this approach extends the responsibility of the producer to the post-consumer phase of a product's life-cycle.[18] For such purposes, tools such as product life-cycle assessment (LCA) have been developed. By estimating and highlighting the various environmental impacts associated with extraction of raw materials, production, the use and disposal of a product, LCA helps industry to detect the most problematic aspects of their whole production system; it also provides consumers and decision-makers with a valuable comparison between similar products. Political incentives can then support the alternatives which entail fewer consequences for the environment and public health.

In its efforts to reduce the hazards caused by dangerous chemical substances and to drive the industry towards cleaner production, the European Union (EU) has developed strong legal instruments that go beyond simple incentives. The REACH (Regulation on Registration, Evaluation, Authorization and Restriction of Chemicals) directive, for instance, came into force on 1 June 2007. One of the main achievements of this regulation has been to make industry responsible 'for assessing and managing the risks posed by chemicals and providing appropriate safety information to their users'. In addition, this directive includes the possibility for the EU to phase-out highly dangerous substances. On the other hand, once past the tests imposed by REACH, substances can circulate freely within the EU. Substances recovered from waste are still subject to this regulation, but a number of exemptions exist.[19]

An earlier regulation, the 2006 RoHS (or Restriction of the use of certain Hazardous Substances in electrical and electronic equipment) has a more specific target. It forces EU member states to ensure that new electrical and electronic equipment entering the market does not contain concentration values of six banned substances (lead, mercury, cadmium, hexavalent chromium, polybrominated biphenyls or polybrominated diphenyl ethers) in quantities exceeding specific maximum levels. Considering the rise in e-waste production, expectations are high regarding these instruments and other international initiatives addressing the same issue.[20] A first encouraging note

The EPEAT Registry:
Rating electronic products according to environmental criteria

The Electronic Product Environmental Assessment Tool (EPEAT) helps consumers evaluate laptops, desktop computers and monitors on the basis of precise environmental criteria, encouraging manufacturers to get greener (and helping them to communicate about their efforts).



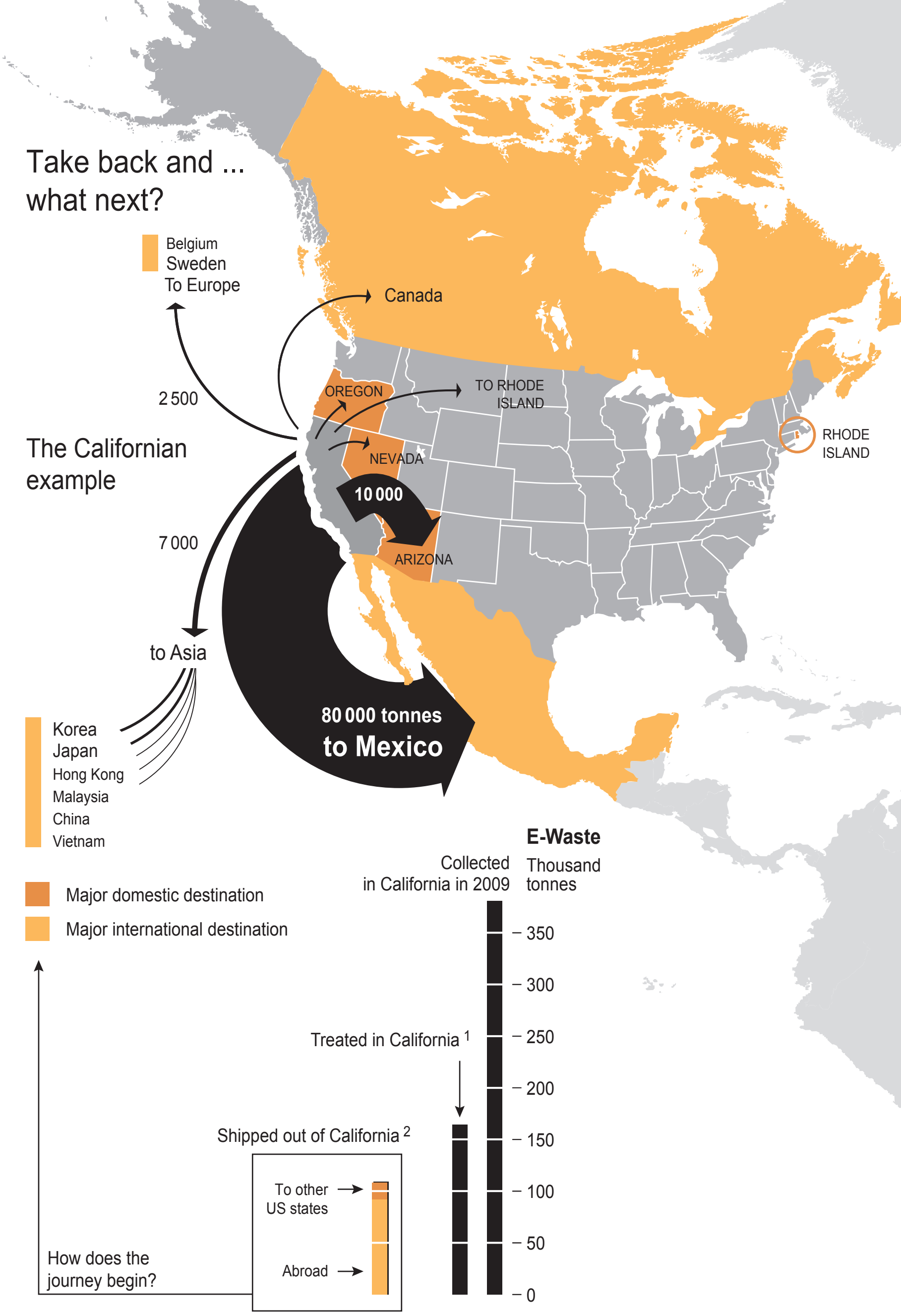
1 - Some criteria are required, others optional. A product must meet all of the required criteria to be added to the registry. It is then rated Bronze, Silver or Gold depending on how many of the optional criteria it meets.
2 - Country registering is esssential because take-back, recycling - among others - can only be assessed locally.

Source: EPEAT®, global registry for greener electronics, 2011 [www.epeat.net].

is that the fraction of pollutants and hazardous components in e-wastes has already seen a steady decline over time.

Complementary to the strategies already described (clean production, waste management strategies, life-cycle approach), the development of green (or eco-) design or take-back campaigns can be harnessed by appropriate EPR-based policy measures. Green design (or eco-design, Design for Environment) seeks 'to ensure that all relevant and ascertainable environmental considerations and constraints are integrated into a firm's product realization (design) process.' Indeed, 'a significant proportion (ranging from 70 per cent to 90 per cent) of any given product's ecological footprint can be addressed at the design stage.' The EPEAT (as Electronic Product Environmental Assessment Tool) global registry was set up to encourage manufacturers of electronic products to get 'greener', while helping them to communicate about their efforts. Its purpose is also to help consumers evaluate laptops, desktop computers, and monitors according to precise environmental criteria.

On the other side of the life cycle, the take-back campaigns organized and financed by the private sector, aim to ensure a high-recovery rate of different types of waste. The most prominent type targeted by recent policies is e-waste. The complex structure of electrical and electronic products contains several hazardous substances, such as heavy metals (mercury, cadmium, lead), flame retardants, and other potentially harmful substances. The improper disposal of such waste causes major health impacts and environmental degradation.[21] Tackling this issue is therefore a major challenge both during the design process and at the end of life. The Waste Electrical and Electronic Equipment (WEEE) Directive passed in 2002 by the EU aims to ensure that manufacturers and importers take charge of recovering their products from consumers and disposing of this e-waste using environmentally sound methods. Despite this regulation, 2008 reports indicate that 'only one third WEEE arisings appear to be collected, treated and reported according to the WEEE Directive, and that trade to developing countries appears to be widespread.' Indeed, WEEE take-back policies, like any EPR-base instrument, face serious implementation problems when there are strong economic incentives to export 'used' or 'end-of-life' products to developing countries. The outlook is hard to predict: e-waste generation will increase, but technology for appropriate disposal should improve as resource scarcity and energy costs increase too.



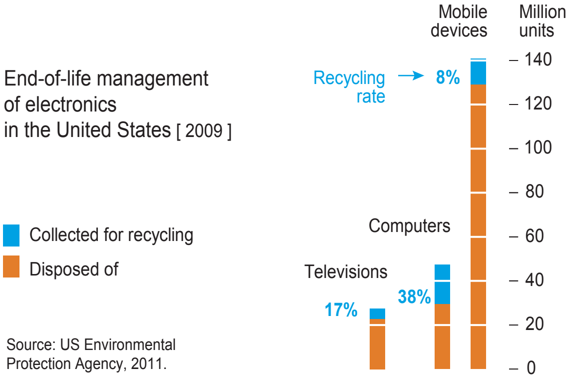
Take back and ... what next?

The Californian example

Please note that when comparing tonnes, quantities of exported e-waste can appear comparatively low because most e-waste collected are intact devices which weigh much more than parts (the latter being predominantly shipped abroad).

1 - Dismantling mostly. 2 - Parts mostly.

Source: California Department of Toxic Substances Control, 2011.



End-of-life management of electronics in the United States [2009]

Source: US Environmental Protection Agency, 2011.

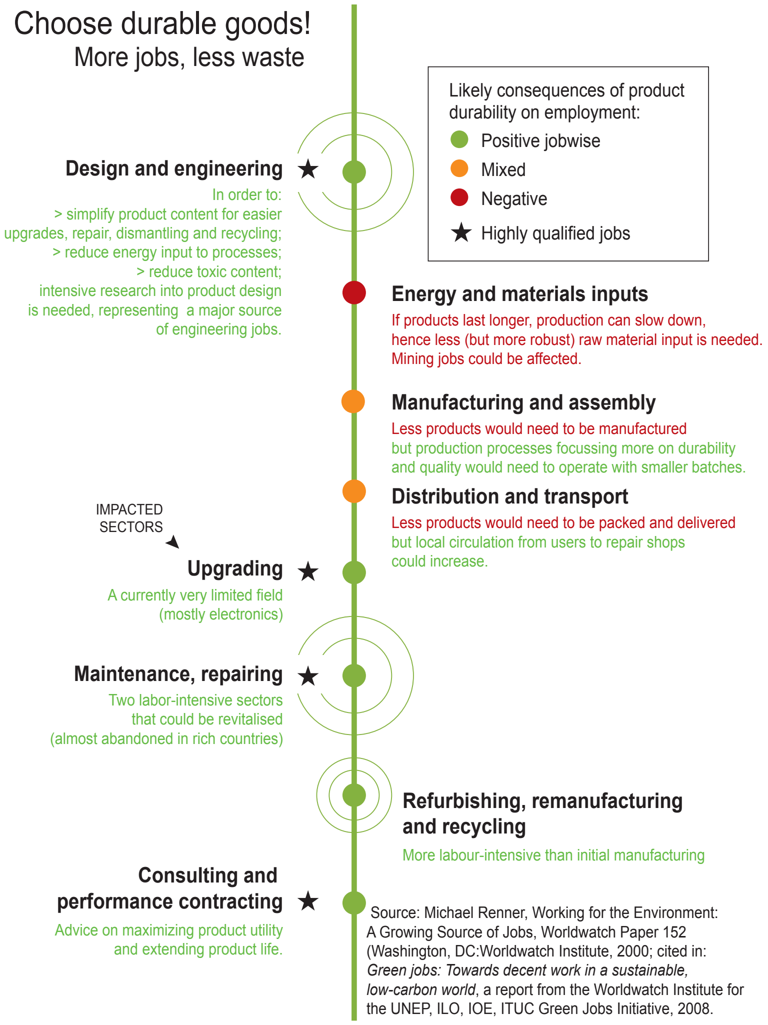
PRODUCER AND CONSUMER RESPONSIBILITY

CITIZEN WASTE

Today, minimizing waste does not only imply the necessary changes in technological and industrial strategies. To address the challenges posed by waste in a serious and responsible manner involves far-reaching changes in behaviour and a shift towards the 'cultural obsolescence' of mass consumption. Sooner or later the depletion of certain resources, environmental degradation and health impacts are likely to weigh on the decision.

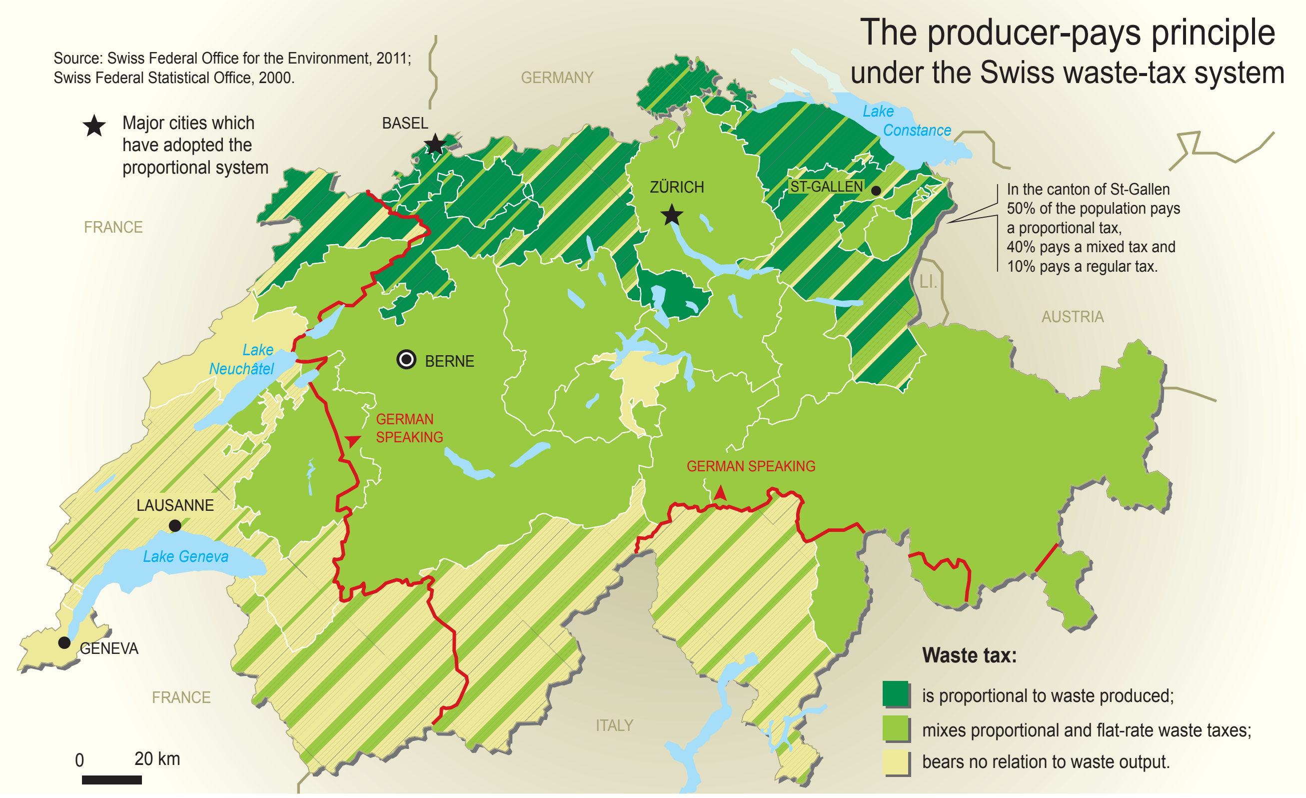
Consumers, among others, have a part to play in how long the goods they consume may last. A product's lifespan varies, for instance, depending on how it is used and maintained. Changes in styles and preferences also affect product life expectancy; but the responsibility for fostering these changes is, much as for positive improvements in new products, often attributed to business and its obsolescence-based marketing strategies, or to political measures (ban or restriction of certain hazardous substances, for instance). Although historical evidence supports this argument, it takes three to make a bargain, to build an economic rapport linking supply and demand within a regulatory framework designed by governments. Ultimately, by discarding less and consuming differently (preferring durable goods or collaborative consumption) and through appropriate handling methods, consumers can reduce their own impacts.

To foster such behaviour some countries or cities have introduced a proportional fee system for household waste (charged per waste bag or by weighing waste on disposal). The rationale is simple and consistent with the well-known polluter-pays principle: the more waste you produce, the more you pay. This type of public measure can cause controversy, as the Swiss example shows. One basic assumption is that the waste management sector is fully operational, which is not the case globally. But by funding waste disposal through taxes, contributions match revenue levels. At first sight the switch to a fee proportional to waste production, as applied in certain Swiss regions, is interesting, but it omits the social justice aspect. The impact of the incentive is much greater on large families and low-income actors. Moreover, the increase in waste sorting in some regions has often been accompanied by higher amounts of illegal dumping due to the lack of harmonization between cantonal regulations within the Swiss federal State. This example shows that regulations and incentives can have a wide range of impacts that need to be assessed to avoid serious drawbacks. Nevertheless the higher up the waste-production chain such changes can occur, the more likely and predictable the effects will be. The infrastructure and administrative resources needed to implement such a tax system are far too heavy for many contexts. Reducing packaging in a few companies will yield much more concrete results than end-of-pipe solutions targeting thousands of households.



Source: Michael Renner, Working for the Environment: A Growing Source of Jobs, Worldwatch Paper 152 (Washington, DC:Worldwatch Institute, 2000; cited in: *Green jobs: Towards decent work in a sustainable, low-carbon world*, a report from the Worldwatch Institute for the UNEP, ILO, IOE, ITUC Green Jobs Initiative, 2008.

Food waste, for instance, poses different challenges in the developing and developed world. In general, while the former faces major production losses (including distribution), the amount of waste in the latter often comes from inappropriate consumption. To work properly mass production needs a large, fully functional distribution system; with inappropriate conservation technologies and capacity, developing countries, more vulnerable to climate change, suffer considerable losses before food reaches consumers. On the other hand, food waste in developed countries is caused, among other things, by strict sanitary regulations which discard goods that could still be consumed, as 'out-of-date', and consumer habits which see throwing away edible food as perfectly acceptable. A change in consumption patterns often



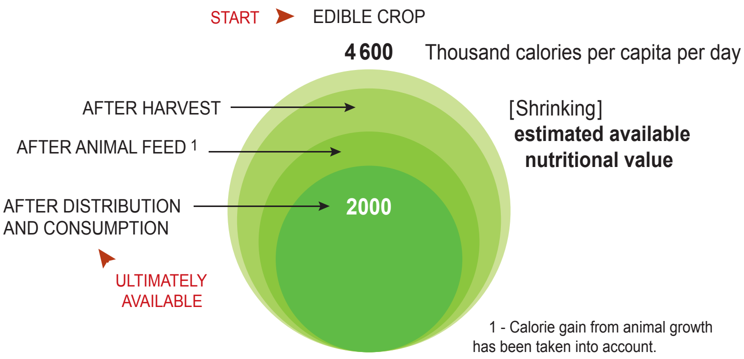
The producer-pays principle under the Swiss waste-tax system

Source: Swiss Federal Office for the Environment, 2011; Swiss Federal Statistical Office, 2000.

In the canton of St-Gallen 50% of the population pays a proportional tax, 40% pays a mixed tax and 10% pays a regular tax.

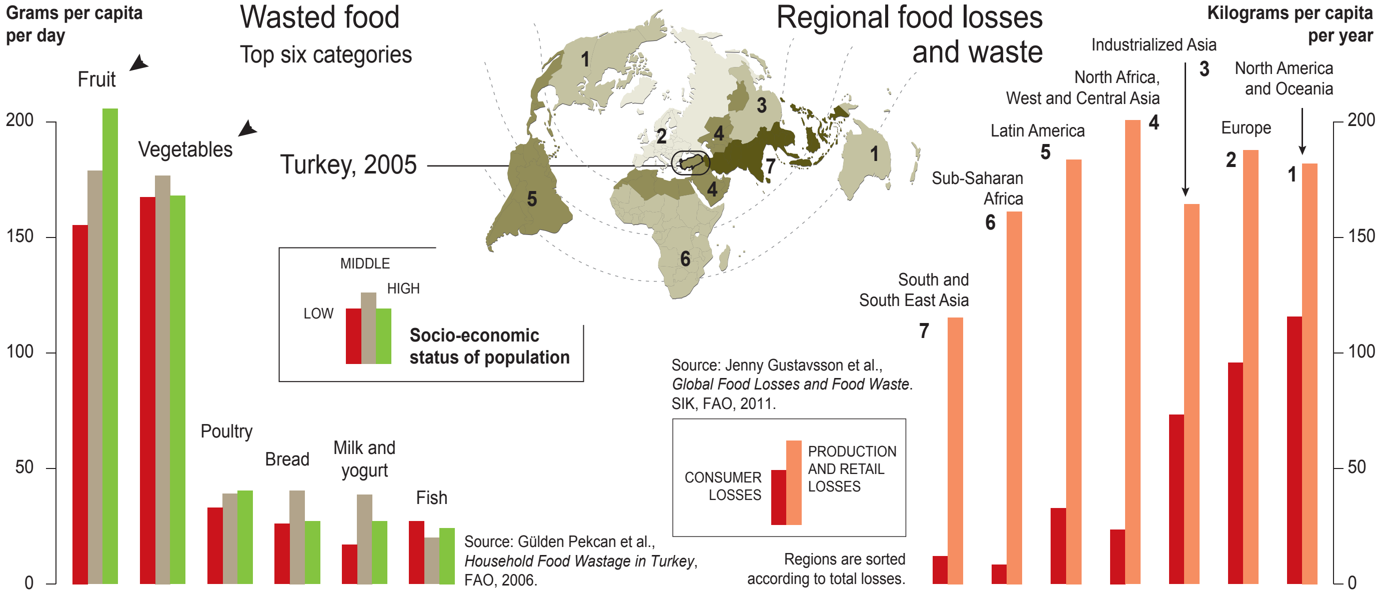
requires political and economic incentives, but a large share of responsibility is borne by consumers. Such action basically requires adequate, reliable information, and scope for choice, both of which are scarce in many parts of the world. In developing countries necessary changes to production and distribution systems put responsibility back in the political and economic arena, in view of individual citizens' low-level of capacity. Nevertheless, for both sides of the food problem, on-going examples show that local initiatives can sometimes achieve things, which those on high are often reluctant or unable to do.

Global losses along the food supply chain



1 - Calorie gain from animal growth has been taken into account.

Sources: Vaclav Smil, 2000; Jan Lundqvist et al., *Saving Water: From Field to Fork – Curbing Losses and Wastage in the Food Chain*, Stockholm International Water Institute, 2008.



Wasted food

Top six categories

Source: Gülden Pekcan et al., *Household Food Wastage in Turkey*, FAO, 2006.

Regional food losses and waste

Source: Jenny Gustavsson et al., *Global Food Losses and Food Waste*. SIK, FAO, 2011.

Regions are sorted according to total losses.

DISASTERS AND WASTE

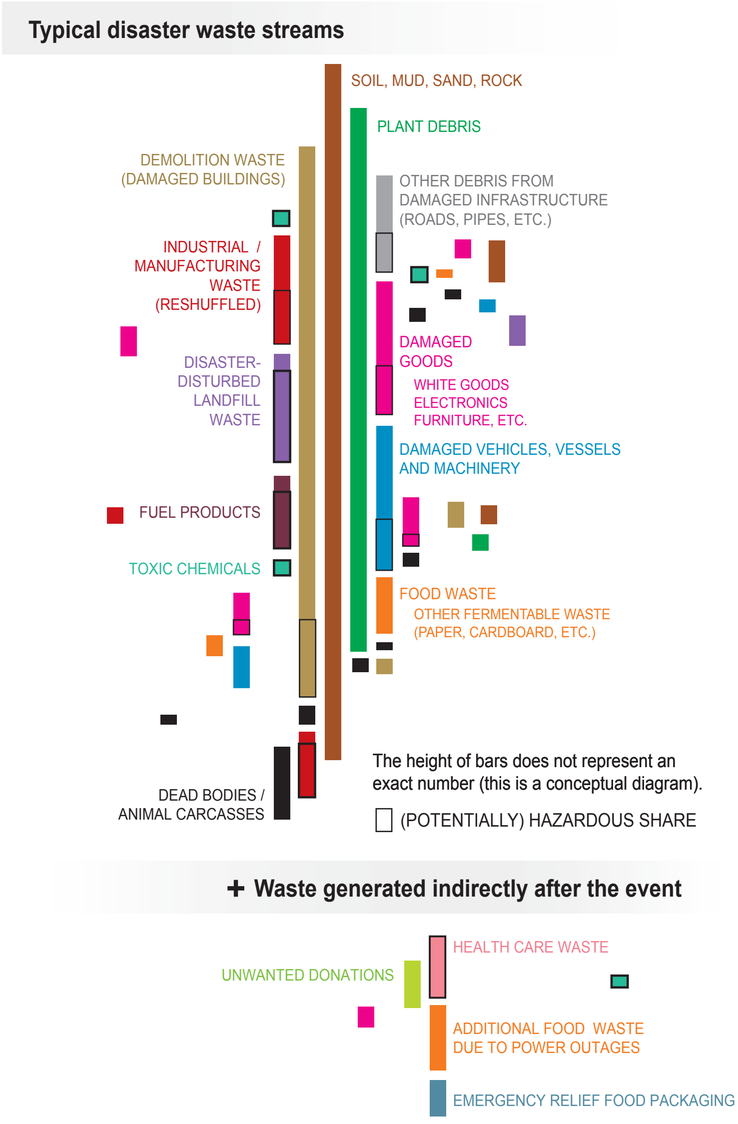
The terrifying pictures of entire villages being washed away in Japan by the March 2011 tsunami following the biggest earthquake ever registered give an idea of the tremendous amount of debris left behind after such an event.[22] While volume is the essential challenge, a significantly more complex dimension is added by the potentially hazardous nature of chemicals present in modern society.

When disasters strike, exposure to hazardous substances is dramatically increased. Electronic equipment, cleaning products, medical and industrial waste all contain hazardous components that may affect human health and the environment.

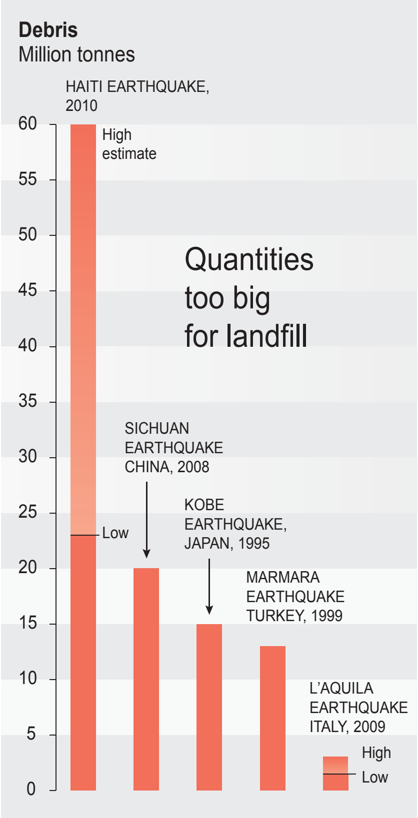
Waste management is a crucial part of reconstruction in the aftermath of a disaster. Yet aid agencies present in post-disaster areas are specialized in humanitarian and medical aid, emergency food and shelter logistics, seldom in waste disposal. After the Haiti earthquake in 2010, large amounts of debris obstructed the rapid progress of reconstruction efforts. Moreover, whereas food packaging just added to the volume of waste in general, 15–20 per cent of the waste produced as a result of the provision of first aid to the 300 000 people injured had hazardous characteristics (drugs, chlorinated hydrocarbons and other chemicals and bacteria). Together with out-of-date or inappropriate medicine received as part of unwanted donations, medical-waste management was a major challenge. The local infrastructure, already inadequate for handling waste before the tragedy, could not cope with such hazards. Fortunately several hospitals were equipped with incinerators, which reduced the amount of medical waste dumped or burned on open ground.

This example shows that without well-designed post-disaster waste-management schemes, disaster wastes are likely to cause major challenges that will exacerbate the dramatic consequences of the catastrophe itself. On the other hand, the re-use and recycling of debris can become a valuable resource for the rebuilding process, with a positive effect on social and economic recovery.

Sorting things out in the remains

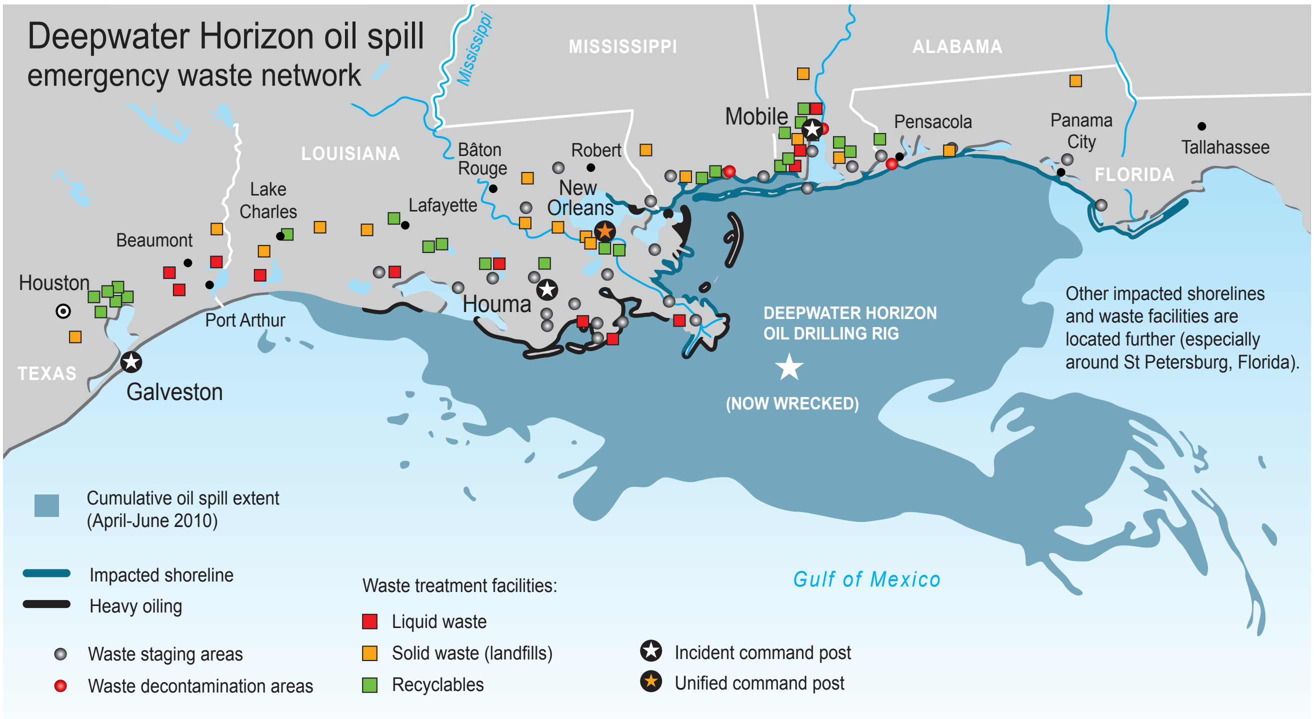


Sources: Modified from Charlotte Brown et al., 2011; US Federal Emergency Management Agency, 2007.



Source: Charlotte Brown et al., *Disaster waste management: A review*, International Journal of Integrated Waste Management, Science and Technology, February 2011.

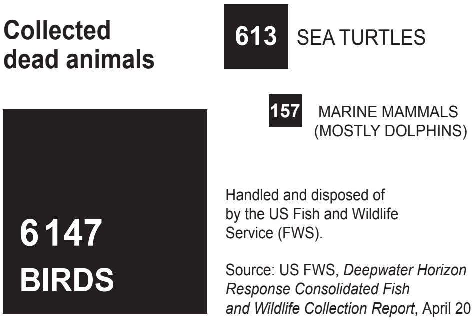
Deepwater Horizon oil spill emergency waste network



Sources: ERMA GeoPlatform (www.geoplatform.gov/gulfresponse), National Oceanic and Atmospheric Administration, University of New Hampshire; Unified Incident Command, US Government Official Website (www.restorethegulf.gov).

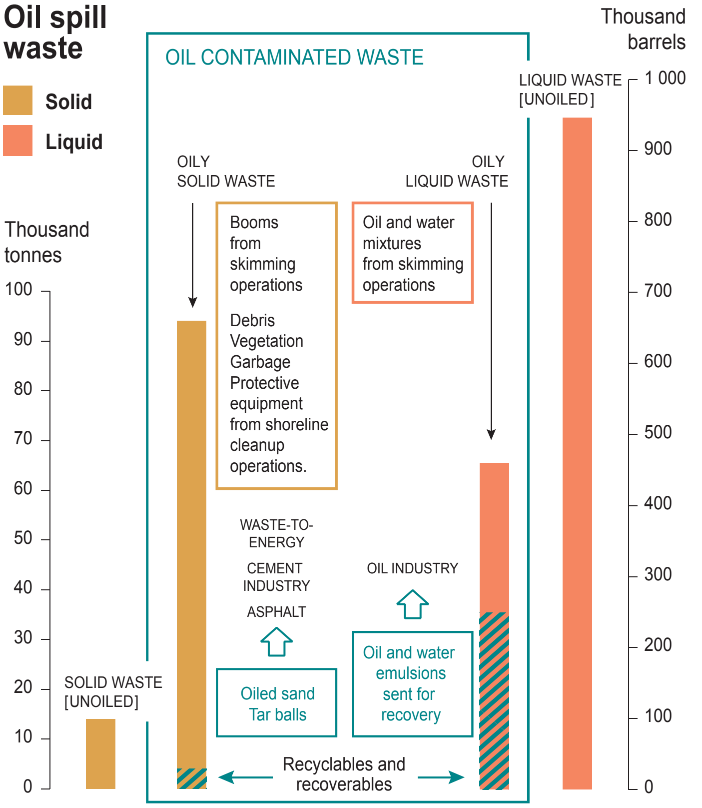
After the explosion and sinking of BP's Deepwater Horizon oil-extracting platform in the Gulf of Mexico in 2010, 50 000 tonnes of boom and oily debris were landfilled, and more waste is being collected from what reappears on the ocean surface or the shore. This waste is an additional burden for human health and the environment in a region already devastated by the 2005 Hurricane Katrina (generating more than 75 million m^3 of debris).

Industrial and official waste disposal sites with inadequate risk protection pose threats by the mere presence of hazardous substances. In October 2010, for instance, a tailing dam holding back a sludge pond owned by the Hungarian Aluminium company in Ajka (Hungary) broke during heavy rain and storms. Some 600 000 to 700 000 m^3 of highly toxic aluminium sludge were released into the Danube river and flood plain, contaminating 800 hectares of fertile arable land and forcing whole villages to be evacuated. This tragic example was a further illustration that we should not underestimate the power of natural events, and that such factors should be emphasized in risk assessments for industrial facilities and infrastructures which produce or contain hazardous substances. Adequate risk assessments covering the whole waste management process are even more necessary in light of the increased chance of intense precipitation and flooding due to climate change.



Handled and disposed of by the US Fish and Wildlife Service (FWS).

Source: US FWS, *Deepwater Horizon Response Consolidated Fish and Wildlife Collection Report*, April 2011.



Not included: animal carcasses (see opposite), medical and municipal waste related to response operations
Source: BP Waste and recoverable material tracking, cumulative total, June 2011.

WASTE CRIME

In general terms, waste crime can be defined as irresponsible behaviour related to waste management that entails damages for human health and/or the environment. Weak levels of legal protection and of awareness may foster criminal activities in the field of waste management, and such crimes will primarily affect those most vulnerable.

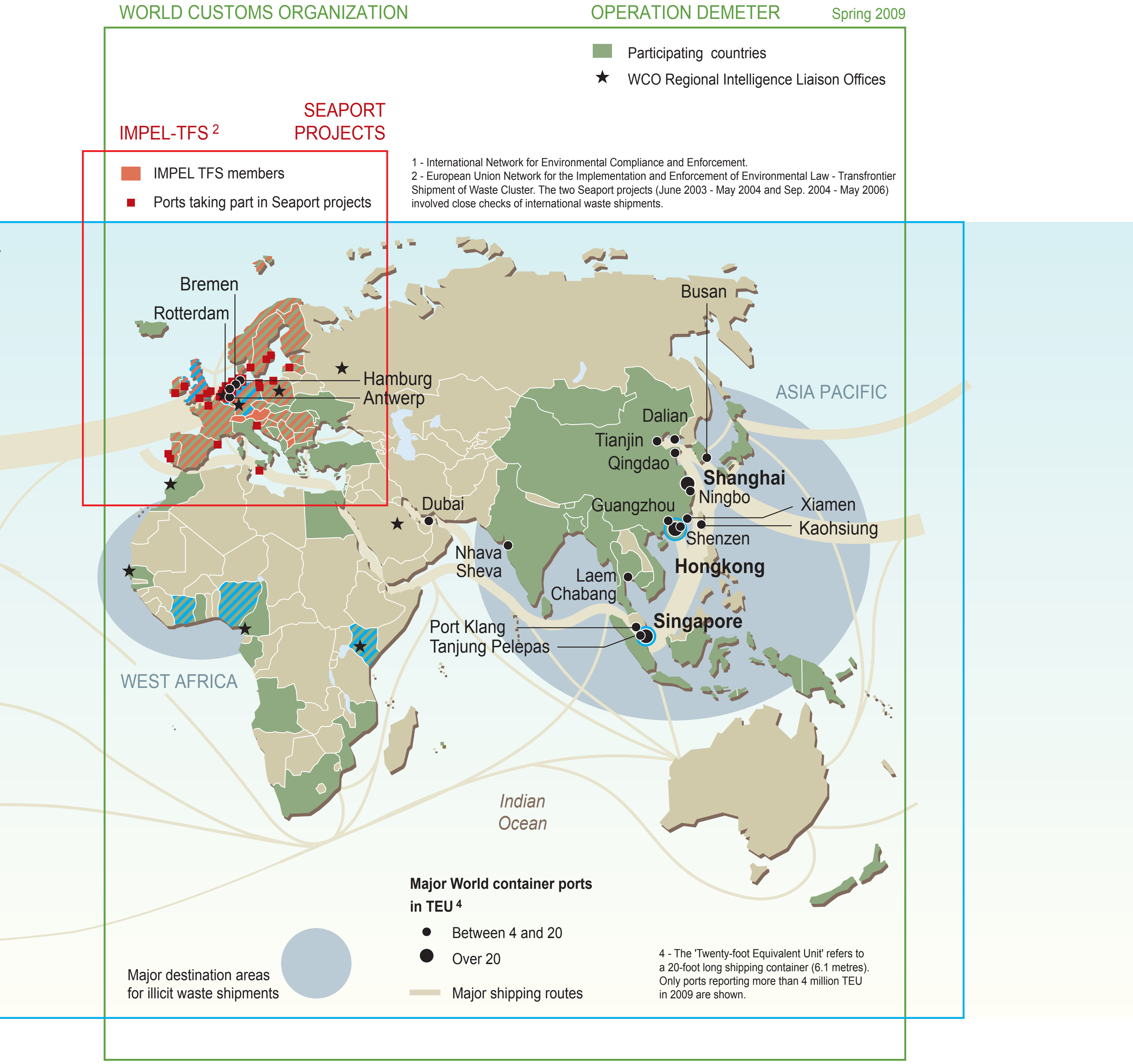
The moral element of the above mentioned definition may seem far-reaching; but, the protection of those most vulnerable actually underpins many legal norms or standards, both at the national and international levels. Enforcing rules and regulations is a complex and costly process in terms of financial, human and political resources. However, a lack of effective enforcement may unfortunately encourage criminal behaviour.

At the international level, any attempt to estimate the global volume and economic weight of illegal trade (or traffic) in waste is hampered by the difficulty of obtaining direct evidence in the absence of systematic controls of transboundary movements. UNEP and the Green Customs Initiative[23] nevertheless indicate that 'national and international crime syndicates worldwide earn an estimated US$20–30 000 million annually from hazardous waste dumping, smuggling proscribed hazardous materials, and exploiting and trafficking protected natural resources.' In addition to the challenges of monitoring and detecting criminal conduct, there are varying definitions or appreciations, from country to country, of what constitutes 'waste', 'hazardous waste' and 'illegal shipments' of hazardous waste.[24] To make things even worse, most developing countries apparently lack an adequate legal framework enabling them to effectively define, prevent and combat illegal traffic.

Examples of international cooperation
on fight against waste trafficking

INECE[1]

In the past decades, the OECD and the European Commission have introduced regulations prohibiting the export of hazardous wastes to, respectively, non-OECD and non-EU member states.[25] These efforts complement the adoption, at the global level, of a ban (not yet in force) prohibiting countries that are members of the OECD and the EC as well as Liechtenstein from undertaking transboundary movements of hazardous wastes to developing countries and countries with economies in transition. Unfortunately, the impact of these measures remains unclear. European enforcement operations between 2007 and 2009, targeting waste movements within the EU and to countries outside the EU, showed that of the waste shipments inspected, 15–18 per cent infringed EU regulations. In spring 2009, a similar but larger operation steered by the World Customs Organization, Operation Demeter, lead to the seizure of more than 45 600 tonnes and 1800 pieces of illegal hazardous waste (scrap metal, household waste, e-waste, used vehicle parts). Out of the 86 seizures, a majority was made in European countries, such as the Neth-



1 - International Network for Environmental Compliance and Enforcement.
2 - European Union Network for the Implementation and Enforcement of Environmental Law - Transfrontier Shipment of Waste Cluster. The two Seaport projects (June 2003 - May 2004 and Sep. 2004 - May 2006) involved close checks of international waste shipments.

4 - The 'Twenty-foot Equivalent Unit' refers to a 20-foot long shipping container (6.1 metres). Only ports reporting more than 4 million TEU in 2009 are shown.

erlands, Belgium and Italy, hosts of the main European harbours. Again, it is extremely difficult to assess the harm to public health and the environment caused by illegal trafficking. The risk of confusing the negative impacts due to legal or illegal traffic is high; but when significant damage occurs in relation to transboundary shipments of hazardous wastes, it is highly likely that illegal trafficking is involved. This statement is without prejudice to the fact that the amount of hazardous wastes imported by developing countries might, in fact, be fairly small compared to the hazardous wastes generated on the spot, with certain notorious exceptions (when national supply is highly dependent on the import of specific waste streams / see previous chapters).

On all these subjects, the positions held by official or institutional sources may differ from civil society reports. What everyone agrees upon, however, is the serious harm that the unsound management of hazardous and even non-hazardous wastes causes to well-being and the environment.

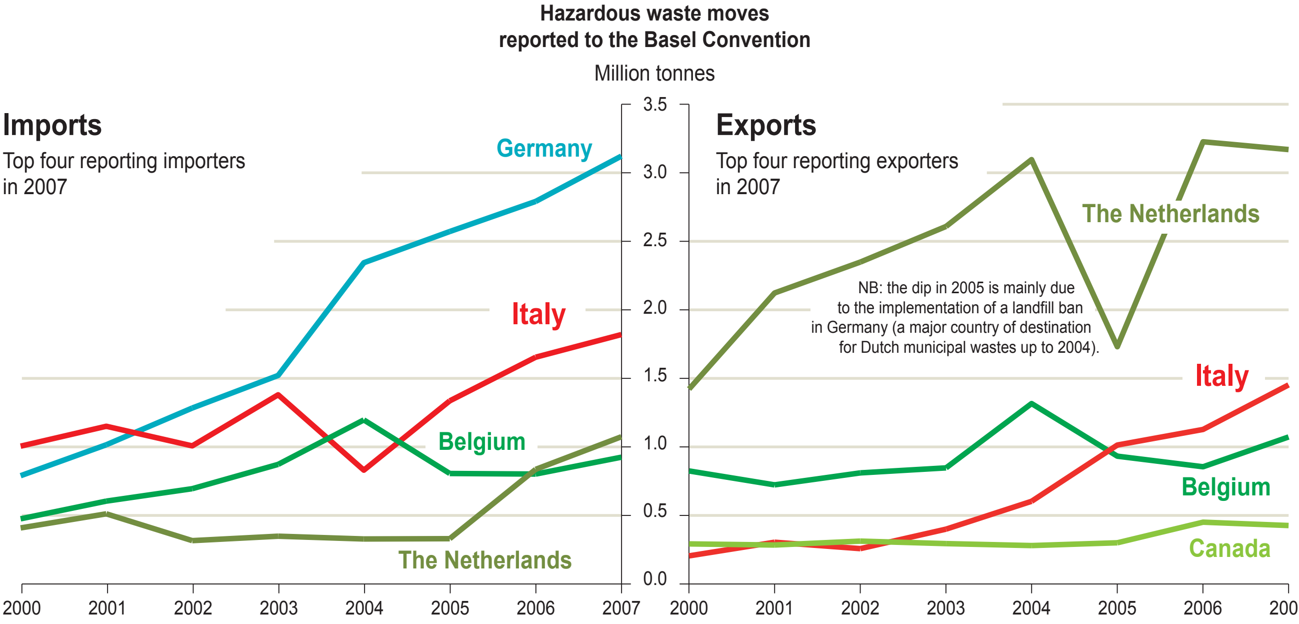
GOOD GOVERNANCE AND ILLEGAL TRAFFIC

The recent waste crisis in Naples, Italy, has drawn public and political attention to the involvement of powerful (Mafia) criminal organizations in the lucrative business of 'managing' hazardous waste outside the regulatory framework.

According to the Italian association Legambiente, 20 000 tonnes of hazardous waste produced by Italian industry disappears annually, either dumped (on land or in the sea) or illegally exported to other countries. The price to pay for the community is high: large areas of farmland, lakes and forests around Naples are contaminated by illegal waste dumps. High levels of dioxins and other toxic substances have been detected in various agricultural products. As a developed country, a member of the European Union, OECD and other supranational bodies, one might assume that Italy has implemented and enforces appropriate national legal and institutional frameworks. It also seems fair to argue that Italy has access to the necessary means and technology to ensure environmentally sound waste management and to ensure that the rule of law is complied with. And indeed, the Italian authorities and civil society are already taking action. This, however, is only one example among many reported around the world; and in an overwhelming majority of cases, countries lack most, if not all, of Italy's resources to face the challenges posed by the environmentally unsound management of hazardous wastes.

Lack of good governance often goes hand in hand with illegal traffic. Weak institutional and legal frameworks, corruption, insufficient controls and inadequate sanctions are some of the parameters that hinder the effectiveness of environmental standards and open the door to illegal activities. Even developed countries face such challenges. Criminal organizations like the Italian mafia infiltrate the waste management market and divert part of the shipments toward the much more profitable illegal market. The gigantic volume of waste generated across the world and the number of containers moving around the planet however make systematic monitoring and controlling of the entire waste chain an impossible task. In 2010, around 24 million standard-size containers passed through the Port of Hong-Kong, over 11 million through the port of Rotterdam, and still around 2,8 million through the port Gioia Tauro in Calabria, the biggest harbour in Italy and the Mediterranean Sea. Given this context, illegal traffic in hazardous wastes will be best prevented and punished if in addition to good governance, efficient means of detecting waste-related crimes, such as risk profiling and intelligence-led approaches, are implemented.

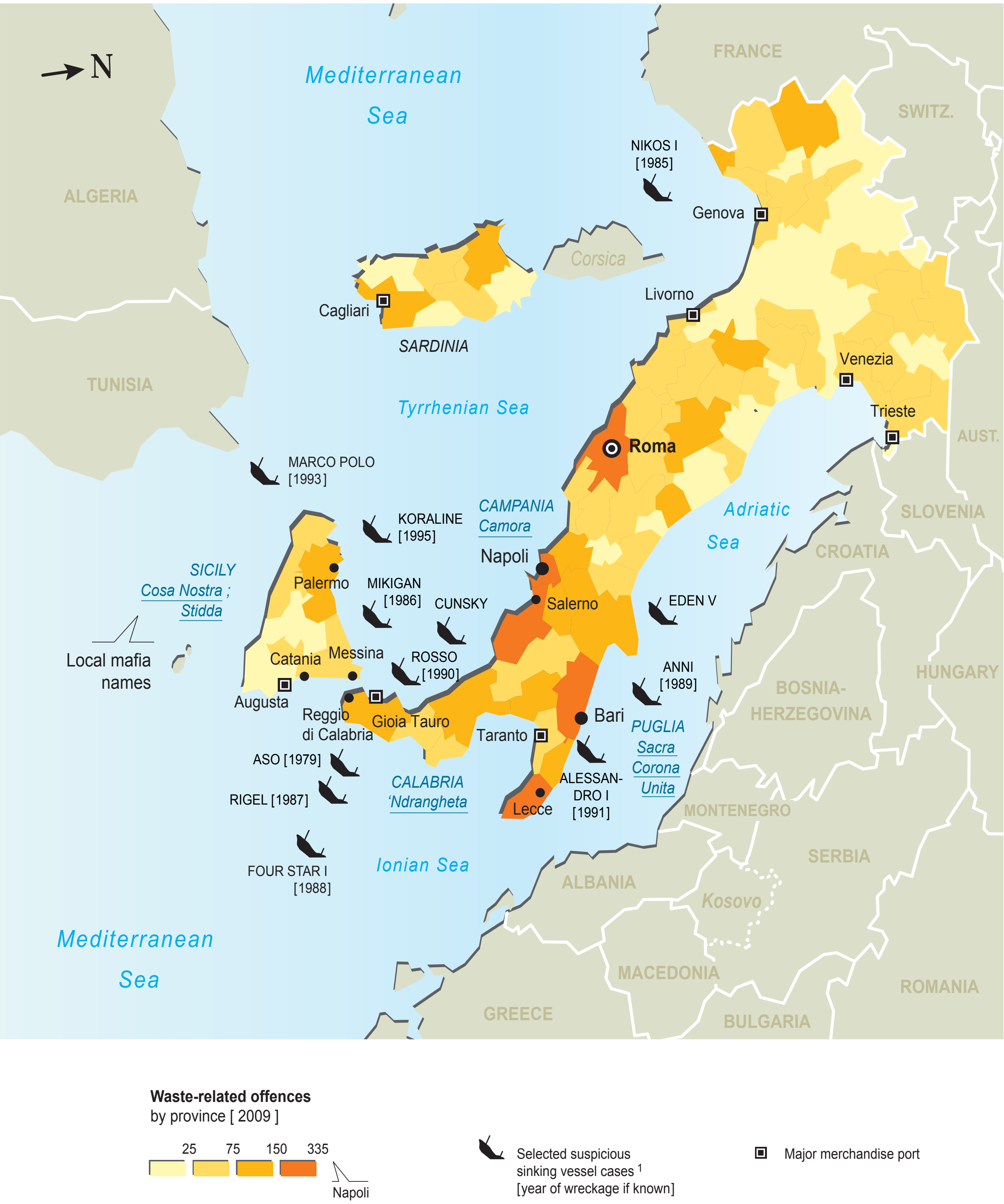
Major partners in the legal hazardous waste trade



NB: the dip in 2005 is mainly due to the implementation of a landfill ban in Germany (a major country of destination for Dutch municipal wastes up to 2004).

Source: Basel Convention, 2011.

1980-90: the peak of waste-trafficking by the Italian Mafia



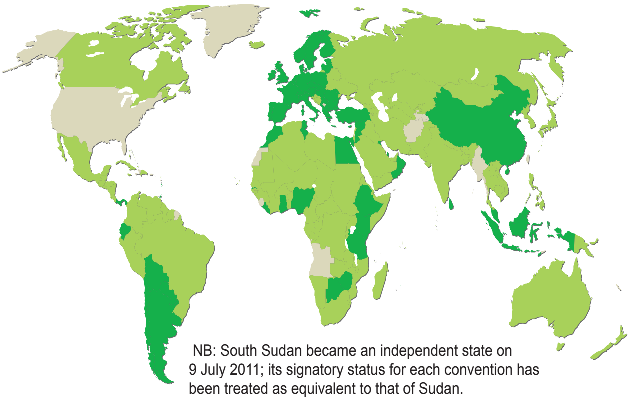
1 - In 2010 Legambiente reported 40 to 100 ships full of nuclear and toxic waste wrecked in the Mediterranean (no May-day signal / no sign of the crew).
In 2009 the prosecutor's office in Reggio di Calabria listed 32 wrecking operations definitely linked to organized crime.

Sources: Legambiente, Ecomafia report 2010; La Repubblica, La mappa degli affondamenti, 2009; Guy Dinmore, Timeline: A catalogue of suspicion, Financial Times, October 20 2009; ISEMAR, Les ports italiens en 2008, 2010.

HAZARDOUS CHEMICALS AND WASTES CONVENTIONS

At the international level, intergovernmental negotiations in the past decades have led to several multilateral legally binding instruments addressing the management of hazardous wastes and chemicals.

The 1998 Rotterdam Convention on the Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade focuses on facilitating information exchange about hazardous chemicals, by providing for a national decision-making process on their imports and exports and by disseminating these decisions to Parties. The 2001 Stockholm Convention on Persistent Organic Pollutants (POPs) lists 22 POP chemicals for which consumption, production and use, import and export, disposal and/or environmental release should be reduced, prohibited and/or eliminated. The most comprehensive global agreement specifically



NB: South Sudan became an independent state on 9 July 2011; its signatory status for each convention has been treated as equivalent to that of Sudan.

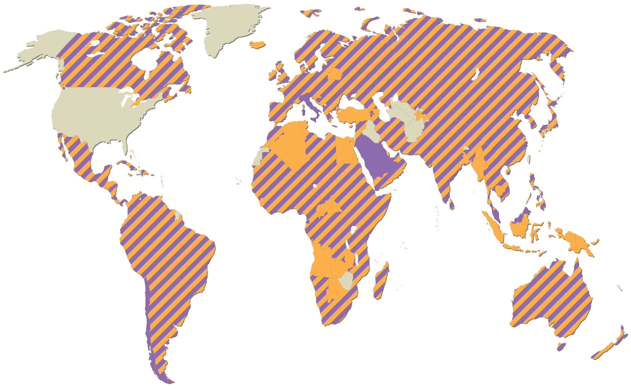
Basel Convention [1989]

on the Control of Transboundary Movements of Hazardous Wastes and their Disposal

🟩 178 Parties

🟩 71 Parties having ratified both the Convention and the BAN amendment [1994] [1]

[1] - Ban on the export from OECD to non-OECD countries of hazardous wastes intended for final disposal [1994], recovery or recycling [1997].



Rotterdam Convention [1998]

on the Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade

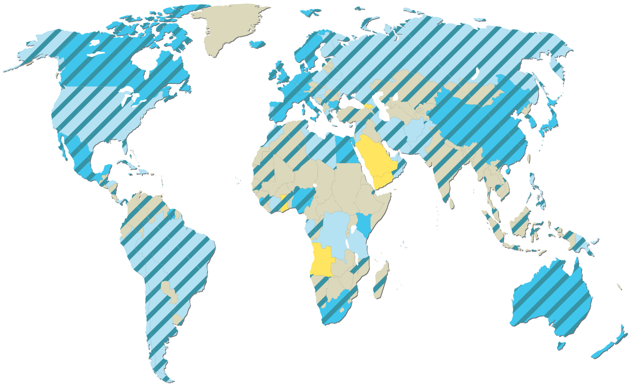
🟪 144 Parties

Stockholm Convention [2001]

on Persistent Organic Pollutants

🟧 176 Parties

▨ Parties having ratified both Rotterdam and Stockholm Conventions



London Convention [1972]

on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter

🟦 87 Parties

🟦 32 Parties having ratified both the Convention and the Protocol [2]

🟨 Protocol only [2]

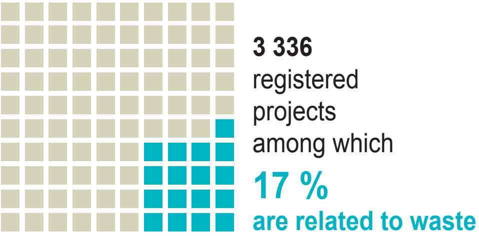
[2] - Under the Protocol [1996], all dumping is prohibited, except for dredged material, sewage sludge, fish wastes, vessels and platforms, inert, inorganic geological material, organic material of natural origin, bulky items primarily comprising iron, steel and concrete, carbon dioxide streams from carbon dioxide capture processes for sequestration.

MARPOL Convention [1973]

for the Prevention of Pollution from Ships

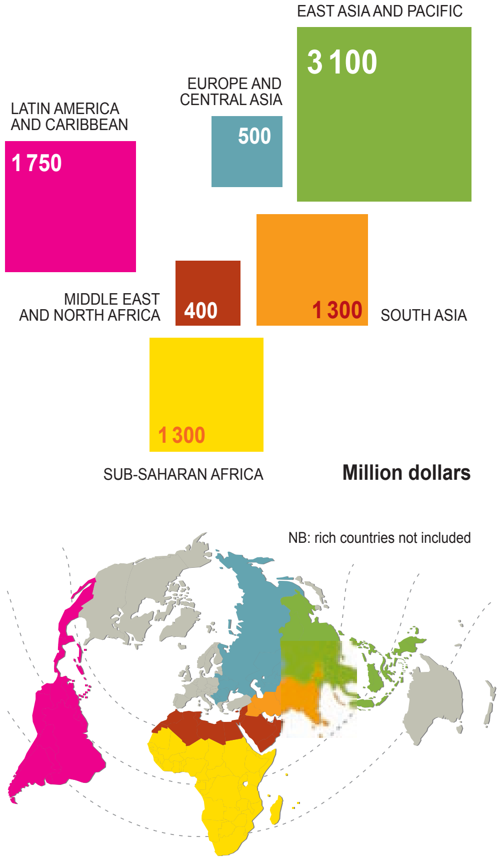
🟦 136 Parties

Clean Development Mechanisms



Sources: UNFCCC, CDM Statistics, July 2011.

World Bank investments
in the municipal solid-waste management sector



Source: World Bank, 2009.

targeting hazardous and other wastes is the 1989 Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal. The main goal of this Convention is the regulation of transboundary movements of hazardous wastes. It has also three additional objectives: to minimize hazardous wastes generation (both in quantity and hazardousness), to treat and dispose of hazardous wastes and other wastes as close as possible to their source of generation in an environmentally sound manner; and to reduce transboundary movements of hazardous wastes and other wastes to a minimum consistent with their environmentally sound management.

Trends in generation and transboundary movements of toxic chemicals and hazardous wastes underline the growing size of the challenge these multilateral agreements are addressing. The increase is indeed global. On one side, the world population is increasing, and with it, resource and energy consumption, pollution, waste generation and transboundary movements.[26] At the same time, material reuse and recycling are also increasing, and the coverage of regulations and enforcement is spreading. Concerns today focus on the rate and magnitude differences between these opposing trends and how they affect the environment and human health. The implementation of the changes necessary to reduce these environmental and health impacts significantly, and to move towards a 'greener' economy, faces a number of obstacles linked to the economic and social costs of change – divergences between waste minimization targets and the waste management market need for waste; consumption behaviours; the quickening obsolescence of various products; or illegal trafficking.

The recent tenth Conference of the Parties (COP 10) of the Basel Convention sent a positive signal in this regard. Parties adopted the Cartagena Declaration on the prevention and minimization of hazardous wastes that gives an impulse towards more consideration of that key objective of the Convention. In addition, the Ban Amendment to prohibit all transboundary movements of hazardous wastes which are destined for final disposal operations from OECD to non-OECD States was given renewed impetus towards its entry into force in the coming future.

Like every treaty, the Basel Convention depends to a large extent on national implementation and the political will of State parties to fulfil its goals. The COP 10 achievements, brought forward by the Country-Led Initiative (CLI) to Improve the Effectiveness of the Basel Convention launched in 2009 by Switzerland and Indonesia, hold encouraging prospects. The CLI's overall objective was indeed to find a solution to the stalemate situation of the negotiations on the Ban Amendment and, more generally, to address problems and obstacles to the implementation of the Ban and of the provisions of the Convention itself, through informal and flexible discussion on a variety of topics, at the centre of which, the problems of transboundary movements of hazardous wastes to countries where environmentally sound management could not be ensured.

NOTES

1. A giant circular oceanic surface current.

2. Persistent Organic Pollutants (POPs) are organic (carbon-based) chemical substances such as pesticides, industrial chemicals or by-products of industrial processes. They possess a particular combination of physical and chemical properties such that, once released into the environment, POPs remain stable for long periods of time, during which they can spread throughout the environment, accumulate in fatty tissue of living organisms and concentrate throughout the food chain. All such substances are toxic to both humans and wildlife.

3. Lavender Law, Kara and Skye Morét-Ferguson, Nikolai A. Maximenko, Giora Proskurowski, Emily E. Peacock, Jan Hafner, Christopher M. Reddy (September 2010). Plastic Accumulation in the North Atlantic Subtropical Gyre. Science, vol. 329.

4. Streams of e-wastes differ from each other in terms of material composition. The most common materials are ferrous metals (iron and steel, more than 50% of the total weight), plastics (~20%) and non-ferrous metals (including precious metals, ~13%).

5. See Basel Convention's key objectives (chapter 6), and also OECD work programme on waste minimization, the European Waste Framework Directive, and US National Waste Minimization Program.

6. Venkatesh, Viswanath and Susan A. Brown (2001). A longitudinal investigation of personal computers in homes : adoption determinants and emerging challenge. MIS Quarterly, vol. 25, no1, pp.71-102.

7. Even recovery includes unavoidable material and energy loss (100 per cent recycling is impossible due to the energy required, the collection shortages, the production losses, and the degradation of the recycled material's properties). Again, the development of the recovery industry is necessary; but without appropriate prevention policies, this industry's dependence on waste is likely to cause more waste generation than prevention. In the end, the result is not an absolute reduction in resource consumption and waste production.

8. For the historical background to these notions, see the introduction of Holm, Stig-Olof and Göran Englund (15 January 2009). Increased eco-efficiency and gross rebound effect: Evidence from USA and six European countries 1960–2002, Ecological Economics, vol. 68, issue 3.

9. In fact every commodity has its own market operating differently depending on the nature of the commodity, the trading system and the historical background. Broad consensus now exists that supply and demand alone cannot explain recent developments in these markets. Financial speculation plays a major role in the high volatility of prices. Nevertheless, considering the increasing demand of emerging countries and the finite nature of reserves, the logical course of events will lead to ever increasing prices as depletion of resources becomes more and more visible.

10. See the example of the Philippines on page 19.

11. US EPA definition of organic materials includes yard trimmings, food scraps, wood waste, and paper and paperboard products. Organic food and organic agriculture refer, however, to particular production methods and certifications specific to each country or region. Most of the time these types of production include limitations or a ban on non-organic pesticides and fertilizers.

12. Considering the amount of scrap metal that the decommissioning of nuclear plants produces and the growing importance of the metal recycling industry, mixing of the two streams is a major concern, with material from conventional recycling and contaminated scrap. Official authorities and the media periodically report on incidents in which radioactivity has been measured in scrap metal or material already processed in recycling facilities.

13. GDP: Gross Domestic Product is the total market value of all final goods and services produced in a country in a given year.

14. The issue is complex as two types of flows of end-of-life electrical and electronic equipment exist. A first part of the used equipment is sent directly as waste for recycling or recovery of materials. On the other hand, a number of shipments are labelled 'second-hand' and sent as products for direct continued use or for continued use after repair or refurbishment. Extending the useful lifetime of this equipment contributes, indeed, to the reduction of overall environmental and health impacts. Unfortunately large portions of this second-hand equipment turn out to be not useable and are disposed of right or shortly after their arrival. This method allows bypassing legal restrictions on e-waste export to countries that do not possess the appropriate waste management policies and facilities.

15. Sourcs: Food and Agriculture Organization (FAO) (2009). The State of Food and Agriculture 2009, Livestock in the balance / World Bank (2005). Managing the Livestock Revolution, Policy and Technology to Address the Negative Impacts of a Fast-Growing Sector.

16. The 'functionality economy' is, indeed, a business model that puts emphasis on the sale of functions, or services, rather than goods. For instance, one could buy an effective 'thermal comfort' service rather than the heating system itself (existing examples: Xerox copy machines, Michelin tyres, IT infrastructure). The company providing this service remains the owner of the machine or product; all incentives are there for it to ensure its product to be most energy-efficient, most reliable, and long-lasting. This model is obviously not applicable to all products, and still needs to be tested for viability on a larger scale.

17. The MFA is a method for calculating the material or/and energy flows within a particular system (a production process or plant, an economic region, a city). The difference between the inputs and outputs of a process provides valuable information on the stocks or losses (according to the mass and energy conservation principle).

18. The OECD, which provides this definition, identifies the following instruments for the implementation of the EPR principle: take-back policies, advanced disposal fees, deposit-refund, a combined upstream tax and downstream subsidy, and standards.

19. See the Guidance document on waste and recovered substances (version 2) published by the European Chemicals Agency (ECHA) in May 2010.

20. The issue of green electronics is, indeed, also addressed in several international forums, in particular by intergovernmental bodies dealing with issues of chemicals management, such as the Strategic Approach to International Chemicals Management (SAICM) and the international conventions presented in chapter 6.

21. See graphs on page 27.

22. UNEP Disasters and Conflict branch estimates the total amount of waste generated by the earthquake and the tsunami as between 80 to 200 million tonnes. In contrast, the Japanese Ministry of the Environment declares that the total quantity reaches 25 million tonnes of disaster waste.

23. The Green Customs Initiative is a global partnership between international organizations including the World Customs Organization, UNEP, Interpol, and the secretariats of relevant multilateral agreements such as the Basel, Rotterdam and Stockholm Conventions. Its aim is the prevention of illegal trade in environmentally-sensitive commodities and the facilitation of the legal trade in these.

24. For the definition of 'illegal traffic' by the Basel Convention, see the section on legal matters of the Convention website.

25. This ban is a direct legacy of the Ban Amendment to the Basel Convention adopted in 1995 but missing yet 17 acceptances for its entry into force.

26. The correlation between demographic growth and resource consumption, waste generation and pollution, for instance, is not equally strong in all socio-economic circumstances. On a global scale, however, we can consider these trends as significantly related.

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DO WE REALLY WANT TO MINIMIZE WASTE?

10-11 HAPPY THROWING AWAY, MR AND MRS CONSUMER!

Basel Convention website: www.basel.int

European Commission. European Waste Framework Directive (available online)

No Impact Man, Colin Beavan's documentary, book, blog and project: noimpactproject.org

OECD. Work programme on waste minimization (available online)

US EPA. National Waste Minimization Program (available online)

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Wasted and wounded, it ain't what the moon did.
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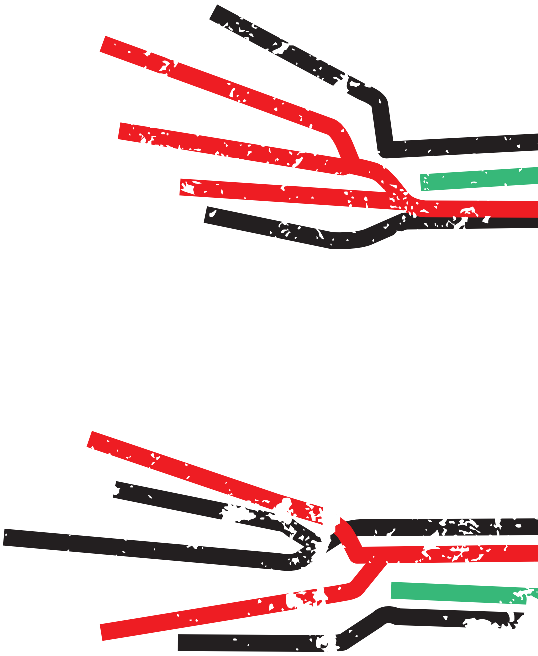

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