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ADDRESSING NEW AND EMERGING WASTE ISSUES THROUGH 3RS APPROACH – POLICY, INSTITUTIONAL AND TECHNOLOGICAL CONSIDERATIONS

(Background Paper for Plenary Session 2 of the Provisional Programme)

Final Draft

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Addressing New and Emerging Waste Issues through 3Rs Approach – Policy, Institutional and Technological Considerations

1. Introduction

Waste is a complex and often neglected issue. Everywhere, whether inhabited or not, one can find waste-prints of humans. Littered streets, waste dumps and smoking waste piles are becoming more and more common sights. From small villages and towns to cities and megapolises, waste has become a major environmental and health issue. It causes all sorts of problems. Dumped waste is a breeding ground for vermin and vectors (disease transmitting organisms such as mosquitos). Apart from the malodorous and unaesthetic character, waste can release harmful substances into the soil and water bodies. Open burning of waste, a common practice in many developing countries, releases toxic gases, including highly carcinogenic dioxins and furans.

Waste is an underlying issue throughout most of the Chapters of Agenda 21 -- the outcome document of the Earth Summit at Rio de Janeiro in 1992 available at: sustainabledevelopment.un.org/content/documents/**Agenda21**.pdf -- either as a cause of a number of environmental problems, or as a result/output of human activities. While Chapters 20, 21 and 22 deal specifically and directly with waste issues, other chapters deal with the impact of waste on other environmental issues. Chapter III of Johannesburg Plan of Implementation -- the outcome document of the World Summit on Sustainable Development at Johannesburg in 2002 available at: www.**johannesburg**summit.org/.../131302_wssd_report_reissued.**pdf** -- lays emphasis on "Develop waste management systems, with the highest priority placed on waste prevention and minimization, reuse and recycling, and environmentally sound disposal facilities, including technology to recapture the energy contained in waste, and encourage small-scale waste-recycling initiatives that support urban and rural waste management and provide income -generating opportunities, with international support for developing countries." Waste management was identified as one of the five thematic areas in eighteenth and nineteenth sessions of the Commission on Sustainable Development (CSD). The outcome document – 'The future we want" of the Rio+20 Conference held during 20 to 22 June 2012, at Rio de Janeiro, lays strong emphasis on sound management of chemicals and waste in the paragraphs 213 to 223. Particularly in paragraph 218, it says 'We therefore commit to further reduce, reuse and recycle (3Rs), and to increase energy recovery from waste, with a view to managing the majority of global waste in an environmentally sound manner and where, possible, as a resource'.

The negative impacts of wastes on the local environment (air, water, land, human health etc.) are becoming more acute often resulting in public outcries and demands for action. The impacts of inadequate waste management are not just limited to the local level but are now felt across national boundaries and, in cases like methane emissions, are even affecting the global environment. More and more water bodies (both surface waters as well as ground waters) are getting contaminated. The land under and around waste dumps is heavily polluted and will require tremendous efforts and resources for rejuvenation.

2. Trends of new emerging waste streams in Asia and their impact on health, ecosystem and resiliency

It is estimated that we produce as much "economic" waste (i.e. officially recorded) each year as cereals (2 billion tons) and steel (1 billion tons). Definitions of waste vary from country to country as do reporting mechanisms as well as the reliability of reported data. In the absence of scientific data collection mechanisms, quite often data are reported on an 'estimation' basis. Such data should be taken as indicative of trends rather than relying on absolute values. Generally, the assessment of hazardous waste, particularly industrial hazardous waste, is better due to reporting requirements under the Basel Convention although the reporting rate over the years is still quite low[1]. The data on waste streams like waste agricultural biomass and construction & demolition waste are generally the weakest.

2.1. Municipal Solid Waste

Though not an emerging waste stream, municipal solid waste continues to be the largest waste stream in Asia. High population growth and urbanization coupled with rapid economic growth has greatly accelerated consumption rates in Asian developing cities, which in turn have contributed to the increase in municipal solid waste generation and to changes in waste composition. For instance, the total municipal solid waste amount in the People's Republic of China increased from 31.3 million tons in 1980 to 212 million tons in 2006, and the waste generation rate increased from 0.50 kg/capita/day in 1980 to 0.98 kg/capita/year in 2006[2]. Characteristics of municipal waste management in Asian cities by level of development are given in Table 1.

Table 1: Typical characteristics of municipal solid waste management in Asian cities by level of development

MSW characteristics	**Level of development**		
	Less-developed cities (Less than 2,000)	Rapidly developing cities (2,000-15,000)	Developed cities (16,000-30,000)
MSW collection rate	<70%	80-95%	95-100%
Recycling	Informal	Formal and informal	Formal
Expenditure from Municipal budget (%)	15-40	5-25	1-5
MSW generation (kg/capita-day)	0.3-0.7	0.5-1.5	>1.0

Source: Municipal Waste Management Report, 2010 ISBN 978-974-8257-73-0

[1] See document paragraph 6 of document UNEP/CHW.11/13 submitted to COP11 of the Basel Convention

[2] (Source: Municipal solid waste management in China: Status, problems and challenges, by Dong Qing Zhang, Soon Keat Tan, Richard M. Gersberg published at Journal of Environmental Management Volume 91, Issue 8, August 2010.)

On a more global basis, the typology of municipal waste is given in Table 2[3].

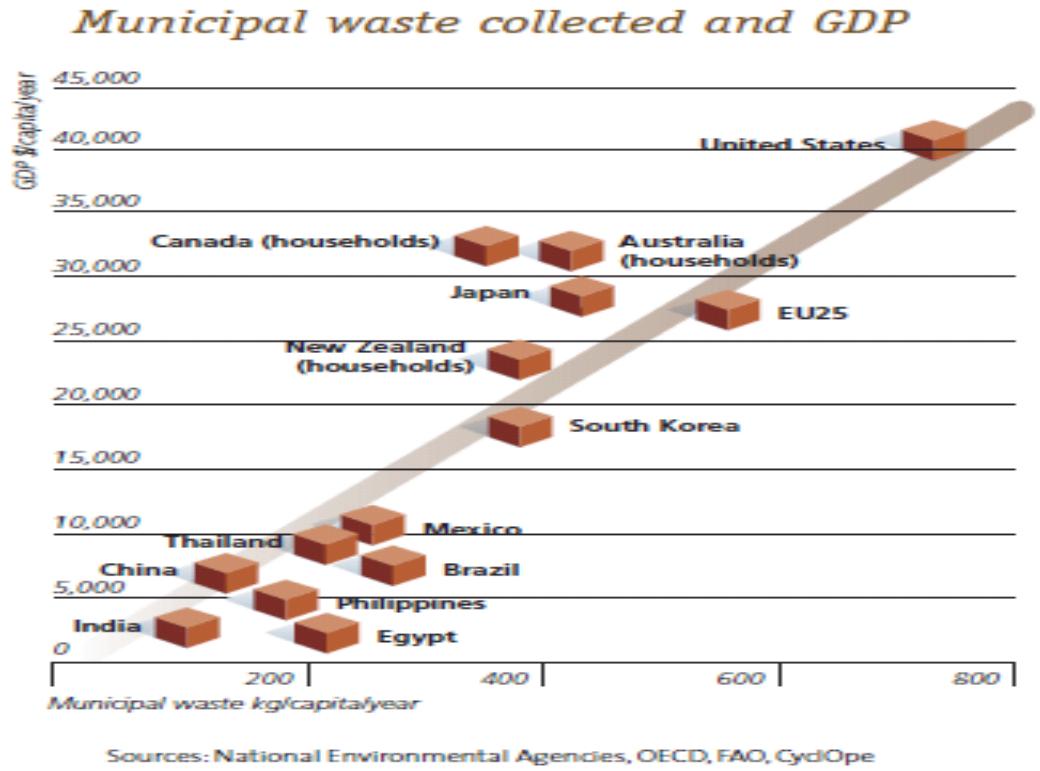
Table 2: Typologies of municipal waste collection and treatment by country income

	Low-income countries – India, Egypt, African countries	Medium-income countries – Argentina, Taiwan Province of China, Singapore, Thailand, EU (10 New Member States)	High-income countries – USA EU_{15}, Hong Kong Special Administrative Region of China
Gross Domestic Product in US$ /capita/year	< $5000	$5000-15,000	>$20,000
Municipal waste Kg/capita/year	150-250	250-550	350-750
Collection rate	<70%	70-95%	>95%
Waste regulations	No national environmental strategy, regulations practically non-existent, no statistics	National environmental strategy, national environmental agency, environmental legislations, few statistics	National environmental strategy, national environmental agency, strict and complex regulations, statistics
Composition Food waste Paper and cardboard Plastics Metals Glass	 50-80 4-15 4-12 1-5 1-5	 20-65 15-40 7-15 1-5 1-5	 20-40 15-50 10-15 5-8 5-8
Humidity	50-80%	40-60%	20-30%
Waste treatment	Unauthorized deposits>50%; informal recycling 5-15%	Landfills> 90%, start of selective collection, organized recycling 5%	Selective collection, incineration, recycling >20%

[3] *Source: Lacoste & Chalmin 2009*

There is generally a correlation between the amount of municipal waste and the Gross Domestic Product (GDP) of the country. The higher the GDP of a country, the higher is the quantity of waste produced. Such relationship is illustrated in figure 1 below.

Figure 1



In many cities in Asia, municipal waste continues to be dumped in open dumpsites. This has serious health and environmental consequences. Improper management of waste including dumping of waste can lead to emission of greenhouse gases. It is estimated that waste dumps contribute as much as 4% of global GHG emissions. Changes in the water chemistry due to surface water contamination can affect all levels of eco-systems. The health of humans and animals which have to use such contaminated waters is adversely affected. It can also contaminate ground water and soil due to seepage of leachate. This in turn affects the entire food chain. Waste dumps are highly disaster prone. The accident at Payatas dumpsite in the Philippines which resulted in death of 200 people and several hundreds were injured is well known. Fires and accidents in dumpsites are, in fact, a frequent phenomenon in many developing countries. The adverse health and environmental impacts of waste dumps are amply demonstrated, for example, in the study carried out by UNEP at Dandora dumpsite in Nairobi, Kenya. [4]

The social ramifications of improper waste management are serious. The weaker sections of society bear the brunt – exposure to unsanitary, unsafe and unhygienic conditions, infestation of vermins and vectors, contaminated soil and water, exposure to emissions and odours, and so on. Some studies have shown that in low income countries up to 2% of population who

[4] Reference: UNEP report – Environmental Pollution and Impacts on Public Health.

earn their livelihood by scavenging useable/saleable materials from dumps are exposed to extremely hazardous and unsafe conditions.

Industrial waste is difficult to estimate. Mostly data is available for European Union, United States of America, Canada, Japan, Republic of Korea, Australia, Mexico, etc. Data from Russia is not available which leaves a large gap. Even for the Republic of China, different sources give different figures; The Organization for Economic cooperation & Development (OECD) estimated it to be 315 million tons in 2002, while a recent estimate issued by the Chinese authorities is about 1 billion tons.

2.2. E-Waste

Electrical and electronic waste, or "E-waste", (also referred to as WEEE-Waste Electrical & Electronic Equipment) is the most important emerging waste stream in terms of rate of growth and its hazardous nature. E-waste is growing rapidly in industrialized countries, but also piling up in developing countries and emerging economies as a result of primary consumption in the developing countries itself and imports of second hand goods. It is forecast that in the Republic of China and South Africa the amount of obsolete computers will rise by 500% by 2020 compared to their levels in 2007
Due to the presence of heavy metals and toxic chemicals the waste is hazardous. Calculating the volume is difficult because of differences in definitions of E-waste and very complex disposal routes. Some estimate it to be in the range of 7 to 13 kg/capita/year. In Europe E-waste is increasing by 3 to 5% per year – almost three times faster that the total waste flow. Globally E-waste is already estimated to be 5 percent of the total municipal waste.
The biggest health and environmental impacts of E-waste are caused by prevailing methods used by the informal sector. Usually, E-waste is first dismantled manually without any protection like gloves or helmets, followed by primitive methods to recover metals like burning of cables or acid-leaching of printed wiring boards. These so called "backyard" recycling methods have low yields and thus lead to the loss of valuable resources. The lack of policies and regulations in most countries and large number of persons involved in dismantling in informal sector allow these practices to continue.

The amount of waste being moved from one country to another is also increasing. As per reports to the Basel Convention it is estimated that between 1993 and 2001 the amount of waste criss-crossing the globe increased from 2 million tons to more than 8.5 million tons, some of which are e-wastes[5]. Quite a lot of it is hazardous waste, which is sometimes exported under the guise of recycling (e.g. waste lead acid batteries, e-wastes) and sometimes illegally for cheap disposal.

2.3. Marine Litter

The marine litter problem is global in scale and intergenerational in impact. Marine debris, or marine litter, includes any anthropogenic, manufactured, or processed solid material (regardless of size) discarded, disposed of, or abandoned that ends up in the marine environment. It was reported during the nineteenth session of the Commission on Sustainable Development held in New York from 2 to 13 May 2011, that the influx of litter into the world's oceans is estimated to exceed 6.4 million tonnes annually and the, while the diversity, distribution and volume of litter is increasing. While there are regional variations,

[5] Source: Vital Waste Graphics 2004.

approximately 80 percent of marine litter comes from land-based sources. It is a complex cultural and multi-sectoral problem that causes tremendous ecological, economic, and social costs around the globe. Solid material anywhere in the environment, can be delivered to marine environments (washed, blown or via nearby waterways) and become marine litter if no mechanisms are in place to intercept these materials. Marine litter is therefore part of a broader problem of solid waste management, which affects all coastal and upland communities including inland waterways and is closely linked to the protection and conservation of the marine and coastal environment and sustainable development. A lack of capacity and funding to effectively manage solid wastes is common, particularly in developing countries, and contributes to the problem of marine litter.

Despite decades of efforts to prevent and reduce marine litter in many countries, there is evidence that the problem is persistent and continues to grow – especially as populations continue to increase.

The issue of marine litter is addressed in several international conventions including: IMO-MARPOL 73/78 Annex V (garbage from ships); London Convention and Protocol on Dumping, Global Programme of Action for the Protection of the Marine Environment from Land-based Activities, etc.

2.4. Waste Agricultural Biomass

The term ‘waste agricultural biomass’, refers to those organic materials, which do not directly go into foods or other products but are necessarily generated in the course of producing crops. Mostly, this biomass is in the form of residual stalks from crops, leaves, roots, seeds and seed shells etc. Common examples are wheat and paddy straw, bagasse (residue from sugarcane milling in sugar production), seed hulls (rice husk, ground nut husk) waste wood from timber processing, etc. Globally it is estimated that approximately 5 billion metric tons of agricultural waste are generated every year – thermal equivalent to approximately 1.2 billion tons of oil – about 25% of the current global production. Amongst Africa, Asia, and South America – Asia accounts for 77% of total waste agricultural biomass generation. Generally, with every ton of crop almost the same amount of waste agricultural biomass is produced. For some crops such as corn and cotton it can even be double.

Currently, especially in developing countries, most of the waste agricultural biomass is left in the field to decompose naturally, releasing CO2 and the high global warming potential greenhouse gas methane or it is open-burnt, emitting gaseous emissions as well as black carbon which also has a high global warming potential. Apart from bagasse, and in some cases rice husk, hardly any of the biomass is being productively used. If properly managed, waste agricultural biomass can be of high value as the energy contained in it can be recovered.

Governments and local authorities in developing countries are largely unaware of the immense potential of converting waste agricultural biomass into energy. While agriculture is a major economic sector in most developing countries, the potential of using agricultural by-products, therefore, remains largely untapped.

2.5. Healthcare Waste

Healthcare waste is another rapidly growing waste streams in many countries. Management of Healthcare waste is becoming an issue of growing concern particularly in urban areas. In many developing countries it is still indiscriminately disposed, often co-disposed with

municipal waste thus causing serious health and environmental threats particularly to the scavengers operating at dump sites. In many developing countries hazardous healthcare waste such as infectious, pathological wastes and sharps are incinerated or open burned and the bottom ash is disposed along with the municipal waste while the flyash is disposed of as hazardous waste. On the other hand, pharmaceutical wastes (including expired medicine) are often left unattended and disposed of along with other municipal waste.

With expansion in healthcare facilities, the quantity of healthcare waste is rapidly increasing. It ranges from 1.0 to 3.0 Kg/bed/day. Although only a small portion of this is hazardous – ranging from 10 to 30% -- if not properly segregated, the entire amount could become hazardous. Lack of knowledge on and awareness of the waste are among the various causes for neglecting this waste stream. Providing reasonable healthcare is itself an issue for many developing Asian country governments, thus addressing healthcare waste has still not received the priority which it deserves.

The city authorities as well as healthcare waste managers are increasingly in need of reliable information on various technology options to safely treat and dispose of healthcare wastes. The technologies for the destruction of certain hazardous wastes, such as healthcare waste, are not well understood or widely available in developing countries. As a result, technology choices, if they are made at all, may not be well-informed, resulting in poor or uneconomic performance. Use of obsolete or inappropriate technologies also results in serious environmental issues due to emissions of dioxins/furans and other contaminants. Moreover, the inability to select recycling or destruction technologies results in waste inventories remaining untreated, giving rise to increasing risks of release to the environment.

2.6. Used Tires

Used tires have emerged as a major waste stream in both developed and developing countries. As a rule of thumb, the used tire generation in industrialized countries is approximately one passenger car tire equivalent per capita per year. It is estimated that in United States of America alone 2-3 billion used tires are stockpiled. USA and Europe are estimated to annually generate 300 million and 250 million used tires respectively. In the Republic of China, approximately 100 million used tires are generated every year. The most obvious hazard associated with the uncontrolled disposal and accumulation of large amounts of tires is the potential for large fires which are extremely detrimental to the environment. Once a large pile catches fire, it is very hard, if not impossible, to extinguish it. In some instances, large tire piles have been burning for several months with the fumes spreading for many miles. Tire piles also pose a serious problem for human health and the environment even if they do not catch fire. Mosquitoes find an ideal breeding ground in the countless puddles which form in virtually every tire as it rains. Especially in areas with warmer climates, mosquito-borne diseases like encephalitis, malaria and dengue fever have been reported around large tire piles. In poorer countries, it is not uncommon to find people using extremely hazardous techniques (such as burning in the open) to recover some valuable materials (such as metals from tire bead wires).

Used tires, instead of being wasted, can be harnessed as a source of materials and energy. Extraction and recovery of metal (bead wires) have already been mentioned. The rubber contained in the tires can be recovered as crumb rubber which has several applications. The tire is built up of materials (latex, styrene-butadyne rubber, carbon black etc.) which can be burnt to release energy.

The governments and local authorities face the huge task of dealing with used tires. With increasing automobiles use in developing countries, the accumulation of used tires is increasing rapidly. The ever-increasing piles of used tires cause severe health and environmental hazard. Proper management of used tires, apart from helping in overcoming these hazards, will also generate resources from waste. It will also help in creating new and green employment as processing of used tires will help to establish a new industry sector. Processing of used tires generates useful products like crumb rubber which can be a valuable resource for industrial manufacturing (crumb rubber products) as well as infrastructure development (used for building roads with longer life and better weather resistance).

2.7. Waste Oils

Waste oil, though not essentially new and emerging, is nonetheless a growing waste stream closely linked with rapid industrialization and increased automobile use. The global lubricating oil consumption is estimated to be 42 million tons in 2010. It is expected to reach about 45 million tons per year by 2015. Due to improper collection, indiscriminate dumping, burning and other inappropriate practices, the estimated amount of waste oil available for recycling and/or destruction is only about 16 million tons per year. Waste oils are generated from a wide variety of facilities including, but not limited to, automotive sector, industries, aviation, marine etc. Asia accounts for almost 30% of global waste oil generation, followed by North America at 22%. It is estimated that globally only about 50% of the waste oil is collected systematically.

Most of the oils contain additives which render waste oils hazardous. In many developing countries some of waste oils are recycled using primitive and obsolete technologies such as open boiling or the acid-clay method which not only give rise to toxic air emissions but also result in hazardous solid waste. The market for such low grade recycled oils is usually limited and the remaining waste oil is either burnt in the open or disposed of indiscriminately. In some cases, the waste oils are also fired as supplementary fuels in combustion systems like cement kilns.

The environmental authorities as well as waste oil generators (industries, fleet owners, ports, railways, defense establishments etc.) are increasingly in need of reliable information on various technology options to safely treat and recycle/dispose waste oils. The technologies for recycling/destruction of waste and used oils, are not well understood or widely available in developing countries. Use of obsolete or inappropriate technologies also results in serious environmental issues due to emissions of dioxins/furans and other contaminants. The inability to select recycling or destruction technologies moreover results in waste inventories remaining untreated, giving rise to increasing risks of release to the environment.

2.8. Waste Plastics

The world’s annual consumption of plastic materials has increased from around 5 million tons in the 1950s to nearly 100 million tons; thus, 20 times more plastic is produced today than 50 years ago. Waste plastics have become a major stream in solid waste. It is estimated that plastics constitutes 15% to 40% of municipal waste depending upon economic profile, lifestyle, and consumption patterns. Large quantities can be found as litter spread in the cities and it being burned, buried or open dumped.

The negatives impacts of unavoidable waste plastics can be addressed or minimized by recycling it and converting into a valuable resource. In most situations, plastic waste recycling could be economically viable, as it generates resources, which are in high demand. Plastic waste recycling also offers greenhouse gas emission reduction potential as co-disposal of waste plastic in landfills causes formation of pockets of anaerobic decomposition of organic waste which can be avoided.

Plastic waste recycling is feasible through mechanical recycling (also called material recycling) which refers to the technologies that reprocess waste plastics into similar or different plastic products without modifying its initial chemical structure. These technologies have the potential for making cheaper products, as in most cases, recycled plastic costs less than virgin plastic.

Feed stock recycling (or chemical recycling) is another viable alternative : plastic waste is recycled as raw materials, fuel oil and industrial feedstock by altering the chemical structure. These products reduce the dependence on scarce materials e.g. partial replacement of metallurgical coke with plastics in steel production. Combustion of plastic waste can be used for energy recovery (or thermal recycling).

2.9. Waste containing nanomaterials

Nanotechnology or manufactured nanomaterials is an exciting new field that promises a broad array of benefits to humans and our environment. However, with these clear benefits come potential risks to the environment and human health - risks that, to-date, are not fully known. United Nations Institute for Training and Research (UNITAR) with Organization for Economic Cooperation and Development (OECD), within the framework of the Inter-Organization Program for the Sound Management of Chemicals (IOMC) were working within the context of Strategic Approach to International Chemicals Management (SAICM) to raise awareness in countries about this new topic - including what the implications for developing and transition countries will be as nano-based or nano-containing products are traded across borders, into jurisdictions where there is little or no capacity to address them. This work received its mandate from Resolution II/4 of the second session of the International Conference on Chemicals Management (ICCM-2), which was held in Geneva in May 2009, which indicated that "[ICCM-2]…encourages Governments and other stakeholders to assist developing countries and countries with economies in transition to enhance their capacity to use and manage nanotechnologies and manufactured nanomaterials responsibly, to maximize potential benefits and to minimize potential risks". The study on the management of waste containing nanomaterials is still undergoing in many OECD countries.

2.10. Other Wastes

Construction and demolition waste is, weight-wise, another large waste stream in urban areas. In developed countries construction waste could be 10 to15% of total waste. In developing countries this waste stream is likely to increase rapidly with the need to replace old buildings and construct new ones to accommodate growing population and expanding economies.

Mining waste takes up a great deal of space, blights the landscape and often affects local habitats. By its very nature it can constitute a serious safety hazard. Globally it is estimated that mining of iron, copper and gold alone requires removal of 33 billion tons of material every year. There are no reliable estimates available for Asia, however it is reasonable to

assume that with increased emphasis on extraction of minerals this waste stream will also rise significantly.

3.0 What to do with waste

Once generated, there are only three things one can do with waste; recycle it, burn it or bury it. Recycling and reuse of waste follow several routes. In developing countries, often materials are segregated from waste and recycled for secondary uses mostly through an informal route. This includes paper, bottles, textiles etc. Discarded products (especially WEEE) are refurbished and sold off as second hand products. Some wastes (such as construction and demolition debris, organic waste converted into compost) are reused for other purposes with little or no processing. Quite often waste is burnt or incinerated to meet the needs for heating energy. In developing countries a significant amount of cooking energy requirements in rural areas is met from waste agricultural biomass whereas in developed countries waste incineration with energy recovery is increasingly favored.

The main materials that are recovered and treated to be reused are:

- Organic materials, wood
- Paper and cardboard
- Plastics
- Glass
- Ferrous and non-ferrous metals
- Textiles
- Batteries
- Waste electrical and electronic equipment
- Special substances such as waste solvents

The extent of recovery/recycling depends on several factors such as the market for recycled materials, the price of recycled material vis-à-vis virgin materials, local economic conditions and so on. The estimated size of the main world secondary material market is given below.

Recycling of scrap metal has perhaps been the most attractive recycling option. It is estimated that scrap metal reuse rate could be globally as high as 60 to70%. The estimated reuse quantities of some metals are:

Steel – 405 million tons (40% of total steel production)
Aluminum – 7.6 million tons (20% of total aluminum production)
Copper – 2 millions tons (13% of total copper production)
Nickel – 0.46 million tons (40% of total nickel production)
Zinc – 2 million tons

Recycling in developing countries is mainly through the unorganized sector; an informal network of rag-pickers (both from primary disposal points as well as intermediate/final disposal areas), door-to-door collectors, primary and secondary dealers and finally to recycling industries. There are no official estimates of the extent of such recycling. Recycling is mainly economics driven as it is a source of livelihood for many unemployed.

Recycling of metals has also very positive environmental impacts since it is estimated that recycling metals saves about 90 percent of the energy used in mining new metals. For example, recycling 10 kilograms of aluminum saves 90% of the energy to produce new aluminum, and prevents the creation of 20 kilograms of CO2 (Source: Schools4Recycling).

It is estimated that the recycling of high value items for example, metal, clean paper and plastic etc. is extensive as compared to that of organic constituents (except for sporadic cases such as that of Bangladesh). In rapidly industrializing countries like India and the Republic of China public-private partnerships are now emerging to use municipal waste as a source of energy.

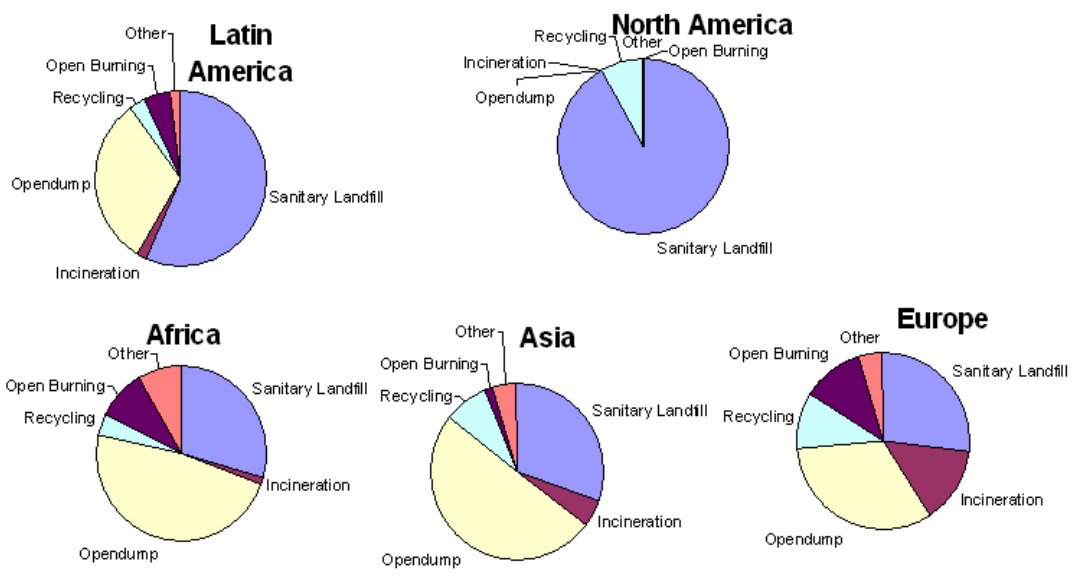
All these require a sound management system with a supportive policy framework and adequate finances. At first burying (better known as landfill) may seem to be the simplest option. However, the potential hazardous consequences (such as auto combustion and seepage of highly toxic leachate) demand that strict controls are exercised in terms of the design and operation of landfills. Composting and/or bio-methanation are also emerging as widely favored technologies to convert clean organic waste into manure or soil conditioner.

Generally, the most widely used technologies used for waste disposal are either landfills (including sanitary landfills, secured landfills for hazardous waste and open dumps) or incineration with or without energy recovery (including open burning). A properly designed and well managed landfill can be a hygienic and relatively inexpensive method of disposing of waste materials provided the geology is suitable and enough land space is available. However, poorly designed or operated landfills can cause a number of problems. Local residents are often hostile to landfills (Not In My Back Yard NIMBY - syndrome). Organic matter in waste, as it rots produces methane which can catch fire or even cause explosions (fires in waste dumps are a common sight). This is also bad for the global environment as methane has 21 times more global warming potential than carbon-di-oxide. The changing composition of waste also leads to other forms of pollution. The bacterial decomposition of waste releases acids which can leach heavy metals such as lead and cadmium into soil and ground and surface waters. If not properly segregated, hazardous materials and wastes such as solvents, motor oil, and mercury-containing light bulbs could further aggravate the situation.

Incineration can be just as bad if not controlled properly. Untreated gaseous emissions contain nitrogen and sulfur oxides which cause acid rain, while particulates cause respiratory problems. A particularly severe problem is release of dioxins and furans which are highly carcinogenic. Studies have shown that in many countries a major source of dioxin and furan emissions is uncontrolled burning of waste. Some countries like the Philippines have completely banned incineration. A well designed and well operated incineration system with proper controls is an expensive affair and is beyond the means of many local authorities.

The global distribution of deployment of various technologies grouped against three classes of economic development of countries is given in graph below.

Figure2



Source: UNEP

In most developing countries waste dumps or open burning continue to be the principal method of waste disposal. Such dumps, apart from causing several accidents, are a continuous source of emission of harmful gases and highly toxic liquid leachate.

4. Major policy, institutional, technology and infrastructure issues and gaps in Asia

In most situations, waste is still considered a problem (having potential environmental, health and social ill-effects) which some how needs to be solved. There is a need for a paradigm shift in the thinking – to consider waste as lost resources and thus minimize its generation and maximize its recycling as a source for materials and energy. Managing waste is a costly affair. It is estimated that OECD countries spend about US$ 120 billion a year disposing off their municipal waste alone and another US$ 150 billion on industrial waste. The World Bank estimates that in developing countries, it is common for municipalities to spend 20 to 50 % of their available recurring budget on solid waste management even if only 40 to 60 % of urban waste is collected and less than 50% of urban population is served. In low income countries, collection alone drains 80 to 90% of municipal solid waste management budget.

4.1 General issues

The issues for solid waste management are multiple.
In general, waste management is a global issue. It is as much relevant in developing countries as in developed countries. It is closely linked to our lifestyles and societal patterns. Rapid increase in volume and types of solid waste and hazardous waste generation is becoming a burgeoning problem for national and local governments to ensure effective and sustainable management of waste.

Waste management has a strong bearing on quality of human life as well as that of flora and fauna. The adverse impacts of improper waste management are very serious and well known. Communities living near dumps suffer from littering, odour, insects and vectors. Scavengers

are at even greater health risks. Substandard landfills and waste dumps emit methane, a major greenhouse gas of concern for climate change.

Waste management requires resources – both financial as well as sound technologies. The World Bank estimates that in developing countries, it is common for municipalities to spend 20 to 50 percent of their available recurrent budget on solid waste management. In low-income countries, collection alone drains up 80 to 90 percent of municipal solid waste management budget. Contrastingly, in high income countries, collection only accounts for less than 10 percent of the budget, which allows large funds to be allocated to waste treatment facilities. Upfront community participation in these advanced countries reduces the collection cost and facilitates waste recycling and recovery.

Finally, the perspective on waste management needs to be changed. It has to be viewed not merely as a problem but also as an opportunity -- waste represents lost resources and there is an opportunity of recovering and reusing these resources.

From the perspective of waste management chain some specific issues are listed below:

4.2 Issues for waste management (as per waste management chain)

a) Source Segregation, Collection

In many developing countries organized and scientifically planned source segregation is missing. Segregation, if at all, is driven by economic factors, except for industrial waste where due to organized nature of sector segregation is sometimes practiced and for healthcare waste due to regulatory requirements. Sorting is mostly done by the unorganized sector (scavengers and rag pickers) and rarely done by waste generators. Consequently, the efficiency of segregation is quite low as the unorganized sector tends to segregate only those waste materials which have relatively higher economic return in the recycling market. The unsafe and hazardous conditions under which the segregation and sorting takes places are well known.

The waste collection efficiency even in large cities is rather low. Often a substantial amount of waste is left to rot on the streets and/or is dumped into low lying areas, canals, rivers etc. Several factors are responsible for such low collection efficiency; lack of appropriate collection systems, lack of and/or inadequate collection facilities such as waste disposal bins, collection vehicles and so on, lack of funds, lack of and enforcement of appropriate regulations etc.

b) Treatment & Disposal

In developing countries, generally no treatment is given to municipal solid waste (MSW) and it is usually disposed as it is. Most of MSW is still disposed off in dumps causing severe environmental and health risks. The progress in moving towards sanitary landfills and/or disposing through well designed and well operated incinerators is rather slow. With the exception of a few developing countries, most hazardous wastes are improperly disposed of together with MSW.

c) Resource Generation

As is well known, a lot of materials can be recovered from waste for recycling which can then serve as an input for manufacturing. Of particular significance are cellulosic materials, plastic, metals and glass. Despite the absence of organized segregation systems, quite substantial amounts of clean plastics, cellulosic material, metals and glass are already

recycled in developing countries due to economic attractiveness. A large number of people ranging from rag pickers to primary dealers, secondary dealers and recycling industries earn their living out of waste recycling. In contrast, organic waste, which constitutes the largest proportion in the waste stream, is often disposed of rather than being segregated and converted into bio-gas, compost etc. Landfill gas is mostly unutilized. Only recently, some efforts have been started to recover energy from waste.

4.3 Issues for waste management (as per action category)

a) Policy issues

In many developing countries, a robust policy framework to give a direction and thrust to environmentally sound waste management does not exist. If at all, the focus of policies is on collection and disposal. Policy measures to promote waste minimization, recycle and recovery are rather lean. Unlike in developed countries (for example, Government of Japan has set the targets under its sound material recycling policy that by 2015. Resource productivity will be enhanced from 26 to 42 million Yen/ton; the recycling rate will be increased from 10 to 15%; and final disposal will be reduced from 5.7 to 2.3 billion tons) no national targets have been set in developing countries to deal with overall issue of waste management in line with country's economic development programme (except in countries like Singapore, Republic of Korea and some others). The environmental policies continue to be based on 'discharge-end control' instead of shifting to a 'source-end based' approach. Industrial policies continue to rely on manufacturing from virgin resources. Rational pricing mechanisms and/or market based instruments to accelerate waste minimization and support greater use of recycled materials are not in place. There is a lack of orientation of waste management programmes towards integrated waste management approach with focus on 3Rs vis-a-vis urban environmental management policies. Most of the current policies are in support of end-of-pipe approach creating huge burden on municipal authorities. Specific policies to promote segregation and reuse at source and to promote conversion of waste into useful materials/energy are not there. Even where policies have been formulated, enforcement is usually weak leading to little or no impact of policies. A summarized list of policies and regulations in different Asian countries is given in Annex-I.

b) Technology issues

There is an urgent need in developing countries to launch targeted efforts for development and acquisition of technologies for material and energy recovery from waste. To build confidence and test the application of such technologies in the context of developing countries pilot demonstration projects need to be established. This in turn will require extensive data collection on waste characterization and quantification to facilitate assessment of recycling/recovery potential and design/development of technologies. Little or no effort seems to be taking place in this direction. Most of the work related to waste management continues to be focussing on augmenting waste collection and building disposal facilities.

The technologies for the recycling, treatment and disposal of waste are not well understood or widely available in developing countries. As a result, technology choices, if they are made at all, may not be well-informed, resulting in poor or uneconomic performance. Use of obsolete or inappropriate technologies also results in serious environmental issues due to gaseous emissions discharge of leachate and other contaminants. The inability to select technologies

moreover results in waste inventories remaining untreated, giving rise to increasing risks of release to the environment.

Currently, technology assessments are typically based on experiences in developed countries and may not be directly relevant to developing countries. It is important to adapt them and/or develop a methodology suited to conditions in developing countries.

c) Financing issues

The cost of waste management is increasing on several accounts. Firstly, the cost is increasing because of the sheer increase in quantity of waste being generated. Secondly, the changing composition of waste with increasing content of non-biodegradables and hazardous substances requires increasing complexity and sophistication in waste management techniques and technologies. Finally, with increasing environmental and health awareness the demands on safe and environmentally sound waste management require more careful and extensive waste management. Already a significant proportion of the budget of local authorities is being spent on waste management yet the services remain unsatisfactory. They are finding it extremely difficult to meet the demand for expanding and improving the waste management system which requires additional funds. Since municipalities continue to shoulder the major burden of waste management it is feared that unless new financing mechanisms are put into place, the waste management situation in many developing countries may further worsen.

Availability of funds to support waste management continues to be the most pressing issues. The local authorities are mostly in a dire financial situation and are barely able to maintain the basic jobs of waste collection and somehow dispose it. Municipal level waste management continues to be heavily subsidised by governments. Financing mechanisms to promote use of environmentally sound technologies, for technology development and demonstration are conspicuous by their absence. As already mentioned, resource price rationalization to support market for recycled materials is yet to take place.

d) Trans-boundary movement and associated illegal trade in hazardous waste

Movement of waste, particularly hazardous waste, within a country and even between countries is another major issue. Movement of non-hazardous waste for the purpose of recycling is sometimes welcomed by recipient countries e.g. importing waste paper for recycling could be a cheaper way of making paper. However, hazardous waste is also moved, sometimes without meeting the requirements of Basel Convention, to take advantage of lower disposal costs in recipient countries irrespective of whether the waste is disposed of in an environmentally sound manner and adequate infrastructure exists or not. Of late, E-waste has emerged as a major stream undergoing trans-boundary movement.

e) Other issues

There are some other broader issues. In particular, one needs to address some location specific issues. The waste issues being faced by Small Island Developing States (SIDS) need to be highlighted. With small geographical areas, relatively smaller quantities of waste (which preclude economic viability of conventional recycling systems) and limited capacity, specific solutions need to be evolved for such areas. Enhanced efforts are required for awareness raising and capacity building. This is particularly important because the knowledge and information levels on modern systems and techniques of waste management

(such as integrated solid waste management, converting waste into resources) are rather low. Waste management continues to be primarily in the domain of municipalities with little or no engagement of different stakeholders. There is a need to establish a regional approach in solving their waste problems and transparent monitoring mechanism and public reporting of results achieved.

5.0 Some effective techniques for waste management

The conventional waste management philosophy of collect-transport-dispose may longer be effective in the current and forthcoming waste scenario. We need to develop and implement innovative techniques, which firstly promote minimizing the generation of waste, and, secondly considers waste as a resources and thus providing business opportunities. Some of these techniques are briefly described below.

5.1 Focus on Reduce, Reuse and Recycle (3Rs)

Scientifically designed waste management systems with a focus on 3R can result in savings in current waste management costs. The volume of 'residual waste' after recovery and recycling of materials can be drastically reduced thus cutting down treatment and disposal costs. In studies conducted by UNEP it has been demonstrated that by adopting the Integrated Solid Waste Management approach the residual waste requiring disposal can be easily brought down to just 30 to 40%. In case the residual waste is sent to landfill, this would also mean that the life of existing landfills will be appreciably increased. Earnings from recovered materials and resources can further ease the budget requirements for waste management.

Employment generation and empowerment of the poor is a major demand in developing countries. Waste management with a focus on segregation and recycling can serve the twin objective of creating employment opportunities for the poor and thus enabling them to improve their life styles. It can be treated as a business opportunity with a good potential for job creation.

5.2 Waste minimization

Although essentially a part of 3R, specific mention of waste minimization has been made because of tremendous scope and potential in this field. Waste reduction at source is increasingly being realized as a component for enhancing competitiveness. Many industrial firms make a special effort to minimize generation of waste so as not only to reduce their waste treatment and disposal costs but also improve their resource efficiency. However, small and medium sized industry experience difficulties in systematically integrating waste minimization actions into their overall management practices – largely as consequence of their time, expertise and money constraints. Waste minimisation at the source of the production process of goods is essential because it is also connected with the minimisation of natural resources uses. It is estimated for examples that to manufacturer one PC and its monitor, it takes 530 pounds of fossil fuels, 48 pounds of chemicals, and 1.5 tons of water. Redesigning such a process could save millions of dollars, emissions and disposed materials.

5.3 Urban mining

Waste is now being termed as a latent resource and the landfills are being increasingly seen as 'urban mines'. Thanks to increasing energy and material costs, recovery of materials and

energy from waste is becoming more and more economically viable. A whole new range of industrial sectors can be developed based on recycling waste materials. The Government of Gujarat in India, for example, is contemplating the establishment of a 'recycling industry park'. Apart from being less susceptible to the vagaries of price fluctuations and limitations in availability of virgin raw materials, recycling industries will also benefit from a cheap and perennial supply of input materials.

5.4 Waste to energy

Recovering energy from waste can become an excellent source of renewable energy. Conversion of organic waste into useful materials (e.g. compost) and/or energy can apart from affecting a significant reduction in waste quantity can provide cheap and renewable energy. Other waste components which are not easily amenable to recycling (such as dirty plastic and paper) can also be converted into fuel, of course with due care for combustion related emissions. Huge quantities of waste agricultural biomass are often allowed to rot in the field (thus causing methane emission) or open-burnt in the field. Establishment of mechanisms for collection and conversion of waste agricultural biomass into energy can provide the countries with a valuable, renewable and carbon-neutral fuel thus reducing their dependence on fossil fuels.

5.5 Involvement of the private sector

Waste management is not just a service to be provided by the government. It is also an important sector of economic activity in which the private sector has a leading role to play. In many cities the entire range of waste management services – collection, transportation, treatment and disposal -- are now provided by the private sector. There is a huge potential for engaging the private sector not only in recycling industry but also in establishing industry based on recycled material as input materials. This can have a snowballing effect in terms of directing private finances, job creation and industrial promotion. The beneficial environmental aspects in terms of reduced extraction of non-renewable resources are obvious.

5.6 Building cooperation between producers and consumers

Producers and consumers are both actors in waste generation. Effective waste management therefore requires full cooperation between producers and consumers. While management of waste generated during the manufacturing process is clearly the responsibility of producers, development and adoption of techniques like 'design for recycle', 'take back systems', 'product-service-systems' and so on. would not only help in reducing waste generation but will also improve resource efficiency by getting 'more from less'. Concepts like 'extended producer responsibility' need to be more widely spread and used. This is becoming more important in current times with increasing supply and demand of equipment and gadgets with models changing very frequently thus generating a large quantity of 'usable' but soon to be 'out of fashion' products. E- waste is one particular waste stream which is tremendously affected by this trend.

Consumers play an important role in waste minimization and waste recycling. Public awareness of waste management issues need to be enhanced. Preferential buying of eco-friendly products will push the market demand of such products. Similarly a preference for recyclable and reusable goods will motivate the producers towards manufacturing more of such products. The consumers can support extensive recycling by depositing end-of-life

products at designated places instead of throwing them away with normal garbage and leaving it to scavengers and recyclers to salvage them.

6.0 International cooperation in addressing new emerging waste streams

A. Providing capacity building and technology transfer for effective waste management

Capacity building at all levels is a key success factor for strengthening the enabling environment for implementation of 3R, waste prevention and waste management projects and programmes including successful technology transfer. To achieve environmentally sound management and minimization of wastes in a sustainable and effective manner, programmes must go beyond purely technical considerations to formulate specific objectives and implement appropriate measures with regard to political, institutional, social, financial, economic and technical aspects.

Experience shows that integrated approaches linking awareness raising, training, promotion of enabling framework conditions and policies, and, when appropriate, technology transfer are effective at creating local capacity and capability for waste prevention and management. To ensure sustainability and replication, the establishment of systems for quantifying, monitoring and disseminating results is crucial. Private sector involvement in waste management systems requires a shift in the role of government institutions from service provision to regulation, which may require the development of new institutional capacities to ensure conditions necessary for successful private sector involvement (e.g. competitive bidding, technical and organizational capacity, regulatory instruments and monitoring and control systems).

A key success factor is the establishment of institutional mechanisms that facilitate co-operation across traditional institutional structures in ways that stimulate increased waste prevention. Multi-level, national/regional/local government partnerships are useful in ensuring that waste prevention activities at various levels are mutually reinforcing. Government and municipal efforts in waste prevention can be promoted by seeking out perspectives from stakeholders (e.g. input during target setting, instrument choice and application, and performance evaluation).

Successful technology transfer does not only involve the selection and shipping of equipment, but also the adaptation of that equipment to local circumstances, the training of local technicians, and the long-term upkeep and use of the equipment, and thus requires both capacity building and the promotion of an enabling environment for technology uptake, development and diffusion. The successful transfer of environmentally sound technologies necessitates that recipient countries have the requisite institutional resources and competencies. If these are not in place, projects need to incorporate strategies to address this e.g. through capacity building measures or activities aimed to improve access to resources. Existing market conditions and market forces need to be considered in the design of technology transfer projects and barriers need to be identified and addressed e.g. through the creation of policy instruments, awareness raising or other measures.

Technology transfer should help strengthen research and development systems and promote the capacity to develop new technologies and solutions. Accurate, timely, and authoritative information is critical to project success including explicit information about government

policies, cost and performance of new technologies, opportunities for international support, or the long-term nature of the necessary technological change Effective strategies include developing niche research areas, particularly in institutions with limited funding, as well as creating research centres and strengthening research infrastructure.

Technical guidelines and manuals for the environmentally sound management of hazardous wastes have been developed under the Basel Convention to assist developing countries in particular, in ensuring proper management of such wastes.[6]

B. Financing and investing in sustainable waste management

Waste management costs are increasing. The global waste market, from collection to recycling, is estimated at US$ 410 billion a year, not including the sizable informal segment in developing countries (Source: UNEP Green Economy Report, Chapter on Waste). Developing countries spend 60 to 70 percent of their waste budget in collection, with complete MSW-related services consuming 1 to 2 percent of a country's GDP. Cost of waste segregation ranges from 107 US$ / ton for mixed collection to 1320 US$/ ton for segregated collection in developed regions. Capital cost of incinerators may range from US$ 100,000 to US$ 200,000 per daily metric ton of capacity compelling the owner to invest at least US$ 30 to 600 million initially. The annual cost per metric ton of waste burned comes to US$ 30 on an average. However, the additional cost of treatment of residual ash in a special landfill may be high ranging from US$ 200 to 500 per metric ton. In a typical city with population of 50,000, the costs of landfilling and incineration are US$ 95 and US$ 147, respectively.

Investing on sustainable waste management is creating more employment opportunities than the business as usual approach for waste management. It is estimated that sorting and processing recyclables sustains 10 times more jobs than land filling or incineration on a per metric ton basis[7].

Government investments in waste management services have also increased over recent times. Energy recovery projects have been the recent focus of Government investments in developed countries. The United Kingdom has allocated US$ 16.5 million for anaerobic 'Waste To Energy' projects. The Republic of China is planning to allocate 862.9 billion RMB (US$ 126 billion) to promote provision and construction of MSW management infrastructure. India has allocated nearly US$ 4.8 million toward SWM under the 11th five-year plan.

Government funding has been however insufficient to meet the growing demand for waste management services in both developed and developing countries. Private participation has addressed many investment barriers successfully through flexible financing options.. The growing number of waste related Private Finance Initiatives (PFI) initiatives in the UK indicates the emerging interest of the public sector in private involvement in the industry. Engaging the private sector has reduced the waste service cost by at least 25 per cent in countries such as UK, USA and Canada and at least 20 per cent in Malaysia. Developing countries should create an environment that encourages the creation of public private partnerships (PPPs).

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[6] http://www.basel.int/TheConvention/Publications/TechnicalGuidelines/tabid/2362/Default.aspx and http://www.basel.int/TheConvention/Publications/GuidanceManuals/tabid/2364/Default.aspx

[7] Source: UNEP/ILO Green Jobs Report, http://www.ilo.org/wcmsp5/groups/public/@ed_emp/@emp_ent/documents/publication/wcms_158727.pdf

Financing options such as micro financing and hybrid financing have been successful in meeting the project costs in quite a few regions of the world. One example is the participatory sustainable waste management project established in 2006 in Brazil which created micro credit funds through donations. These funds were used as a source of working capital for financing transportation and for emergency. The funds were also used to extend loans for waste-pickers who repaid their loans after receipt of payment from recycling depots.

Another example is that of micro-financing for micro-enterprises managing a 40 year old, 2 million metric tons garbage heap called Smokey Mountain in Metropolitan Manila, Philippines. The micro-enterprises are involved in collection, sorting and sale of waste through a Material Recycling Facility (MRF). Micro-financing enabled these enterprises to borrow loans and increase their capacity to generate revenue.

Hybrid financing models are being increasingly explored to rekindle and/or close economically challenged waste management projects. In the United Kingdom prudential borrowing is an innovative financing option that has been introduced by the British Government in 2003. Department of Environmental, Food and Rural Affairs of the Government of United Kingdom recommends applying the option for low-risk investments such as recycling centres or land acquisitions. In one case at West Sussex Council the low-risk element of a MBT process (about 60 per cent) was funded through prudential borrowing.

C. Building partnerships

It is vital to engage communities and non-governmental organizations and other partners in the development of public awareness campaigns and education on waste prevention, waste treatment and disposal. Spreading knowledge and information on health hazards from waste particularly to the vulnerable segments of society such as scavengers and rag-pickers is also very important.

Public-private partnerships can also play an important role in financing and developing waste management infrastructure. Developing such infrastructure (for example, scientifically engineered landfills, segregation and transfer stations, treatment facilities for hazardous waste etc.) could be requiring high investments and may well not affordable by private sector or municipal authorities alone. Such partnerships can also bring in higher efficiency while maintaining the social service component of the development.

Initiatives like the International Partnership for Expanding Waste Management Services of Local Authorities (IPLA), Global Partnership on Waste Management (GPWM) and the partnerships under the Basel Convention (e.g. Mobile Phone Partnership Initiative, Partnership for Action on Computing Equipment) need to be further strengthened and expanded. These are crucial and engaging a wider range of stakeholders and thus bring about synergy while avoiding duplication.

7.0 The way forward – the "future we want"

A number of international and national initiatives have already been launched to promote environmentally sound waste management. UNEP, in partnership with international, national and local partners, has embarked upon intensifying and strengthening its activities in the field of waste management. In support of the Bali Strategic Plan for Capacity Building and Technology Support adopted by UNEP's Governing Council in 23rd meeting in 2005, UNEP's activities especially highlight capacity building and provide support for technology identification, assessment and implementation at national/local level. In 2010, UNEP launched the Global Waste Management Partnership for promoting international dialogue and cooperation in waste management. In 2004 the Government of Japan launched the 3R Initiative at the G-8 Summit. This was followed by the endorsement of the Kobe 3R Action Plan in the G-8 Toyako Summit in 2008. In 2009 the Regional 3R Forum in Asia was established through the joint effort of the United Nations Centre for Regional Development (UNCRD) and the Japanese Ministry of the Environment with an objective to help mainstream 3R into national policies in Asia. The Tokyo 3R Statement, agreed on at the Inaugural Regional 3R Forum held in November 2009 in Tokyo, provides a comprehensive basis for the proliferation of 3R approach across Asia. At the national level the Japanese policy on sound material recycling society has established time-bound target to be achieved. The Republic of China adopted a Circular Economy Promotion Law in 2008 and formed a Circular Economy initiative. Such initiatives are strategically important.

Waste management and **resource recovery** from waste are still low on the socio-political priorities of many countries, particularly developing countries, and national and local policies on waste management are not yet comprehensive enough to cover all types of wastes and all aspects of waste management. In many developed countries, policy frameworks to support resource recovery from waste remain inadequate.

The **priority objectives** in the field of policy options for waste management are to formulate and implement policies that promote **waste prevention and minimization** and support effective and efficient **management** of the remaining solid and hazardous wastes, focusing on **reuse and recycling** and on **the recovery** of useful materials and energy. Countries need to set time bound targets especially regarding aspects like minimization and segregation, recycling and recovery, collection efficiency, treatment and environmentally sound disposal.

An important step should be to improve the quality and reliability of waste related data so that the problem can be defined accurately. The data should not only include the current amount of different types of waste generated, but also the expected future amounts, in order to develop projections that will allow adequate planning for resource recovery and substitution of virgin materials. Governments may like to create 'waste cells' and charge them with the responsibility of collection, refinement and updating waste data from all sources of waste generation and establishing an aggregation process from local data to national level data.

In addition to policy development and implementation, waste management system requires technology and financing to build required infrastructure. Countries need to launch intensive capacity building programmes so as to enable concerned personnel to select, implement and operate the required technologies. Capacity of research and development institutions needs to be enhanced to undertake development and adaptation of technologies to suit local conditions. The role of international organizations in capacity building and enhancing access to

technology is very crucial. The availability of financial resources for building waste management infrastructure in developing countries needs to be enhanced. There is a need to develop and implement innovative financial instruments to raise funds for waste management. Public-private partnerships could be further explored to increase availability of and access to financial resources.

The social aspects of waste management cannot be overlooked. An important element of this in the context of developing countries is the role and status of scavengers/ragpickers. Programmes need to be developed to mainstream this section of society and giving them a proper place in society and decent working conditions.

Management of solid wastes and sewage are essential components of sustainable development, as mentioned in Agenda 21: "environmentally sound management of wastes is among the environmental issues of major concern in maintaining the quality of the Earth's environment and especially in achieving environmentally sound and sustainable development in all countries". As indicated in Agenda 21, chapter 21 waste management is closely related to other programme areas of other chapters (fresh water, sustainable human settlement development, protection and promotion of human health conditions).

A paradigm shift in approach and thinking is required. As per Dr. Paul Connett of Zero Waste, the waste management challenge in 20th century was –

> "How do we get rid of our waste efficiently with minimum damage to public health and the environment?"

In the 21st century, this has to change to -

> "How do we handle our discarded resources in ways which do not deprive future generations of some, if not all, of their value?"

Annex I

Policies/regulations on waste management in some Asian countries

Country	Policies/regulations
Brunei Darussalam	Recommended Procedures for Disposal of Waste Batteries Measures to reduce the use of plastics
Cambodia	- The Law on Environmental Protection and Natural Resources Management (1996) - Law towards any kind of wastes, including hazardous waste management - The Sub-Decree on Solid Waste Management (SSWM) prepared by MoE (1999) - Sub-Decree on Water Pollution Control: stipulates the restriction of inappropriate disposal of solid waste/garbage, which contributes toward the deterioration of the water environment and of human health, including theecosystem. - Sub-Decree on EIA Process: aimed on restricting improper waste management during and after project operations Agencies: Local Authority, MoE and other concerned national and local agencies
Peoples' Republic of China	- Law on the Prevention and Control of Environmental Pollution by Solid Wastes, the revised edition adopted by the 13th Meeting of the Standing Committee of the Tenth National People's Congress on December 29, 2004, effective as of April 1, 2005 - Standard for Pollution Control on the Landfill Site for Municipal Solid Waste(GB16889-2008), the revised edition issued by the Ministry of Environmental Protection on April 2, 2008, effective as of July 1, 2008 - Standard for Pollution Control for Municipal Solid Waste Incineration(GB18485-2001), issued by the Ministry of State Environmental Protection Administration on November 12, 2001, effective as of January 1, 2002 - Technical code for municipal solid waste sanitary landfill (CJJ17-2004), issued by the Ministry of Construction on February 19, 2004, effective as of June 1, 2004 - Technical Standard for Solid Waste Cleaning of Reservoir Bed of The Three Gorges on Yangtze River (HJ85- 2005), revised edition issued by the Ministry of State Environmental Protection Administration and the State Council Three Gorges Project Construction Committee Executive Office, effective as of June 13, 2005 - Control Standards for Urban Wastes for Agricultural Use (GB8172-87), issued by the Ministry of State Environmental Protection Administration on October 5, 1987, effective as of February 1, 1998 - Regulations for the Administration of Prevention of Pollution of the Yangtze River water area by ship's garbage and littoral solid wastes, issued by the Ministry of Communications, the Ministry of Construction and State Environmental Protection Administration on December 24, 1997, effective as of March 1, 1998 - Regulations of the City's Appearance and Environmental Sanitation, issued by the State Council on June 28, 1992, effective as of August 1, 1992 - Notice of Limitation of Production, Distribution and Use of Plastic Shopping Bag, issued by the State Council on December 31, 2007, effective as of June 1, 2008
Indonesia	- Act of the Republic of Indonesia Number 18 Year 2008 regarding Waste Management - Law Number 38 year 2007 regarding Responsibility of Central Government, Provincial Government and Local Government - Act of the Republic of Indonesia Number 23 Year 1997 regarding Environmental Management - law Number 26 year 2007 regarding Spatial Planning

	- Government Regulation Number 21 year 2006 regarding Policy and Strategy of MSW - Government Regulation Number 16 year 2005 regarding Water Supply (Raw Water Protection) - Law Number 32 year 2004 regarding Local Government - Law Number 7 year 2004 regarding Water Resources - Law Number 23 year 1992 regarding Health Ministry of Environment is responsible for providing national policy Ministry of Public Work together with MOE, MOT, MOI, BPPT and Ministry of Home Affair are responsible for preparing guidelines of MSW Local Government is responsible for local operations of MSW management Indonesia is implementing a program on municipal waste management called "Clean City Program/ADIPURA AWARD".
Japan	''Waste Management and Public Cleansing Law'(enacted in December 1970) stipulates that each municipality shall collect, transport and dispose of municipal wastes generated within its area. The National government develops the fundamental policy for waste reduction, the development plan of waste treatment facilities, and gives technical and financial assistance to municipalities. The Ministry of the Environment (MOE) is responsible for MSW management administration at the national level. Recycling of some types of municipal wastes is implemented in accordance with specific separate recycling laws, namely: Container and Packaging Recycling Law (enacted in June 1995, administered by MOE and Ministry of Economy, Trade and Industry (METI)), - Home Appliances Recycling Law (enacted in June 1998, administered by MOE and METI), - Food Waste Recycling Law(enacted in June 2000, administered by MOE and Ministry of Agriculture, Forestry and Fishery), and - End-of-life Vehicle Recycling Law (enacted in July 2002, administered by MOE and METI). 2. Agencies - Local Governments - Ministry of Environment
Republic of Korea	1. Regulations - Waste Control Act, 8 Mar, 1991. - Act on the Promotion of Saving and Reutilization of Resources, 8 Dec, 1992. - Act on the Promotion of Construction Waste Recycling, 21 Dec, 2003. 2. Agencies - Local Governments - Ministry of Environment
Lao PDR	Law on Environmental protection, No. 2/99/NA dated 3 April 1999 Regulation No. 521/MCTPC dated 23 February 2007 Regulation No. 1770/STEA dated 3 October 2000 on environment assessment in Laos
Malaysia	Solid Waste and Public Cleansing Management Act 2007 [Act 672]; Gazetted on 30 August 2007. Imposed by the end of 2008. Give executive power to the Federal Government (Department of National Solid Waste Management) to manage solid waste instead of the Local Authorities. Solid Waste and Public Cleansing Management Corporation Act 2007 [Act 673]; Gazetted on 30 August 2007.

	Responsible agency: Solid Waste and Public Cleansing Management Corporation. National Solid Waste Management Policy; Approved on 13 September 2006. Need to be updated – in line with Act 672. National Strategic Plan on Solid Waste Management. Approved on 20 July 2005. Need to be updated – in line with Act 672. Agencies: LGUs, NSWMD/MHLG, MoE & other concerned national agencies For hazardous waste issues: The Environmental Quality Act 1974, (Amendment 2005) Section 34B; and the Customs (Prohibition of Export and Import) Order 1998 Amendment 2008.Resposible agency: DOE Malaysia Environmental Quality (Scheduled Wastes) Regulations 2005, stipulated under Environmental Quality Act 1974.
Mongolia	Law on household and industrial solid waste on 2003, draft of which is developed by the Government of Mongolia to improve the management of household and industrial solid waste, creating a economic mechanism for reuse and reduction of waste, and managing solid waste to keep environmental balance. The law has been followed since 2004. All the rights and obligations of stakeholders, on waste collection, segregation, treatment and disposal procedure, database, economic regulations and control mechanisms are reflected entirely in the law. Provisions for the implementation of the Law on household and industrial solid waste include the following: - "Rule on hazardous waste certification" - "Methods of waste payment evaluation and norm setting" - "Hazardous waste classification and rate" - "Solid waste disposal construction, sort of dumps and their requirements, responsible persons and organization's acitivities Agencies: MNET
Myanmar	Policies/laws: Proclamation No. 11/90 by SLORC (State law and order restoration council) for Yangon City Development Committee (YCDC) Rules and regulations: Yangon City Development Committee Act 33 (A), (B) (1990), Yangon City Municipality Act – 1922 Development Committee is using the Yangon City Municipal Act 1922 and drafting a new suitable regulation for Nay Pyi Taw The City of Mandalay Development Law
Philippines	RA 9003- Ecological Solid Waste Management Act of 2000 RA 7160- Local Government Code Executive Order 226 – Omnibus Investment Code Department Administrative Order 2001-34 – Implementing rules and Regulations of RA 9003 Department Administrative Order 2006-9 – Guidelines on the closure and rehabilitation of open and controlled dumpsites Department Administrative Order 2006-10 Guidelines on the categorization of sanitary landfill Agencies: LGUs, NSWMC/EMB-DENR and other concerned national agencies
Singapore	Environmental Public Health Act (EPHA), developments are required to provide the necessary refuse storage and collection system which would include refuse bin centre in the premises for the proper management of refuse. The EPHA also provides the legislative framework for the licensing and regulation

	of waste collection and the establishment of approved waste disposal and recycling facilities. There are also provisions in the EPHA for enforcement of offences on illegal dumping of waste. The following Regulations and Code of Practice related to solid waste management supplement the EPHA: - Environmental Public Health (General Waste Collection) Regulations, - Environmental Public Health (Public Cleansing) Regulations - Code of Practice on Environmental Health (COPEH) - Code of Practice for General Waste Collectors
Thailand	- Rules on waste separation at source - Criteria, standards and procedure for managing infected waste - The Enhancement and Conservation of National Environmental Quality Act, 1992 on requirements over the procedures for collection and transportation of community hazardous waste - Registration of operators in the business of waste management and setting operational guidelines - The Town Planning Act, 1975 for mandatory requirement of areas used as site for integrated waste disposal centre - The Public Health Act, 1992 and The Enhancement and Conservation of National Environmental Quality Act, 1992
Viet Nam	Law on Environmental Protection 2005 Decree No. 80/2006/ND-CP dated 09 Aug 2006 of the Government on the implementation of Law on Environmental Protection 2005 Decree No. 59/2007/ND-CP dated 09 Apr 2007 of the Government on Solid Waste Management Decision No. 23/2006/QD-BTNMT dated 26 Dec 2006 of the Minister of Natural Resources and Environment on the issuance of Hazardous Waste List Circular No. 12/2006/TT-BTNMT dated Dec 2006 of the Ministry of Natural Resources and Environment on the Professional Capacity and Procedure for Application, Registration, Permit and Code of Hazardous Waste Management.

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