CSD-19 Learning Centre

"Synergizing Resource Efficiency with Informal Sector towards Sustainable Waste Management"

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Co-organized by: UNCRD and UN HABITAT

Reduce, Reuse and Recycle (the 3Rs) and Resource Efficiency as the basis for Sustainable Waste Management

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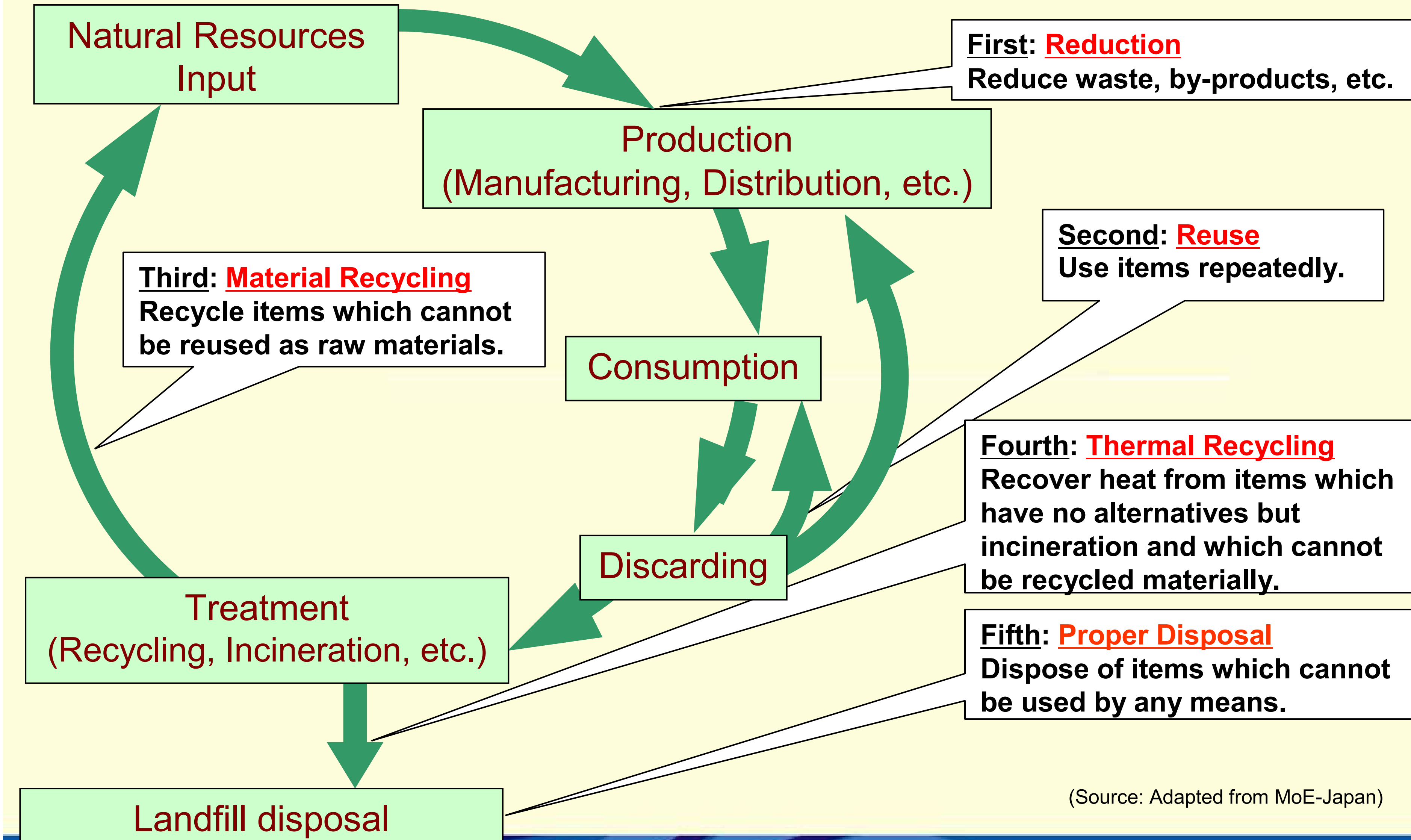
3Rs offer an environmentally friendly alternatives to deal with growing generation of wastes and its related impact on human health, economy and natural ecosystem



(Source: Adapted from MoE-Japan)

Stages in Product Life Cycle

- Extraction of natural resources
- Processing of resources
- Design of products and selection of inputs
- Production of goods and services
- Distribution
- Consumption
- Reuse of wastes from production or consumption
- Recycling of wastes from consumption or production
- Disposal of residual wastes

Source: ADB, IGES, 2008

Figure 1.4: Life Cycle of a Product

Source: Modified from www.environment.gov.au/settlements/industry/corporate/eecp/publications/shop.html

Resource efficiency refers to amount of resource (materials, energy, and water) consumed in producing a unit of product or services. It involves using smaller amount of physical resources and generating less waste to produce the same product or service, and encourages patterns of consumption that use few resources through the design of products and services and their delivery to consumers (ADB, 2008)

Eco-efficiency and the importance of the 3Rs

Eco-efficiency is the delivery of competitively priced goods and services that satisfy human needs and bring quality of life, while progressively reducing ecological impacts and resource intensity throughout the life cycle, to a level at least in line with Earth's estimated carrying capacity.

Seven elements or steps companies can make to improve Eco-efficiency:

1.) Reduce material intensity

2.) Reduce energy intensity

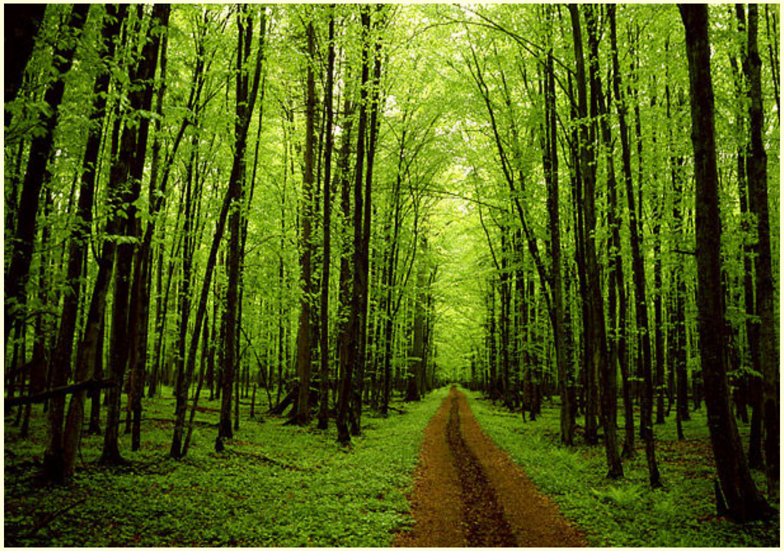
3.) Reduce dispersion of toxic substances

4.) Enhance the ability to recycle

5.) Maximize use of renewable resources

6.) Extend product durability

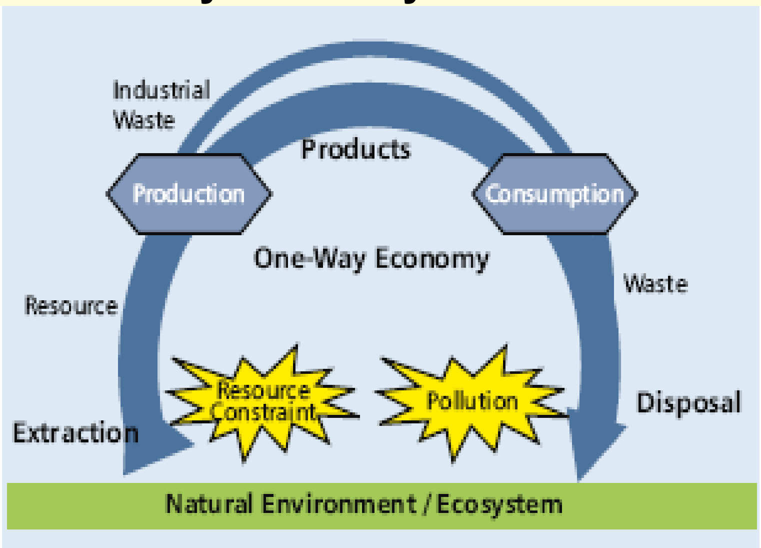
7.) Increase service intensity



Source: DeSimone, Livio, and Frank Popoff, 2000

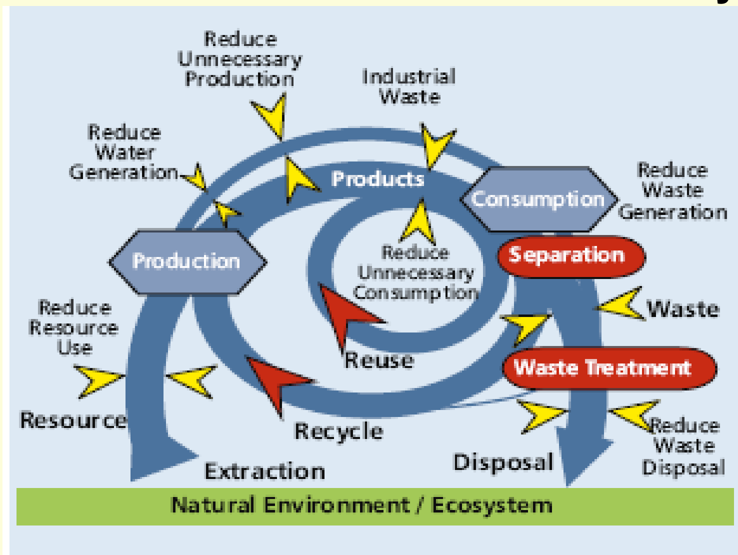
Transitioning to more resource efficient economy

1. One-way Economy



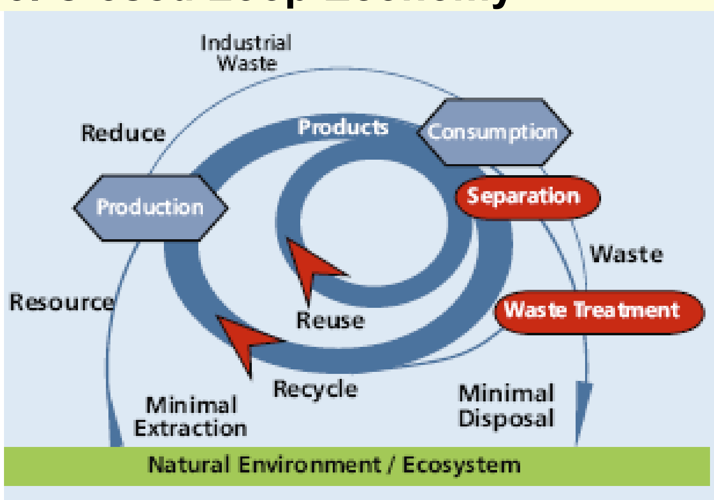
Source: ADB.

2. More resource efficient economy



Source: ADB.

3. Closed Loop Economy



Source: ADB.

1. In one way economy, a little effort is made to reduce the amount of materials consumed in production and hence the wastes are produced. Also little effort is made to reuse or recycle those wastes which mainly go for landfill.

2. Greater resource efficiency by reducing consumption and waste of materials, and by reusing and recycling by products. By implementing measures on both the production and consumption sides, countries may be able to reduce (per unit of product) both the quantity of the resource extraction stream and the quantity and environmental impact of the residual materials flow that ultimately reaches disposal sites.

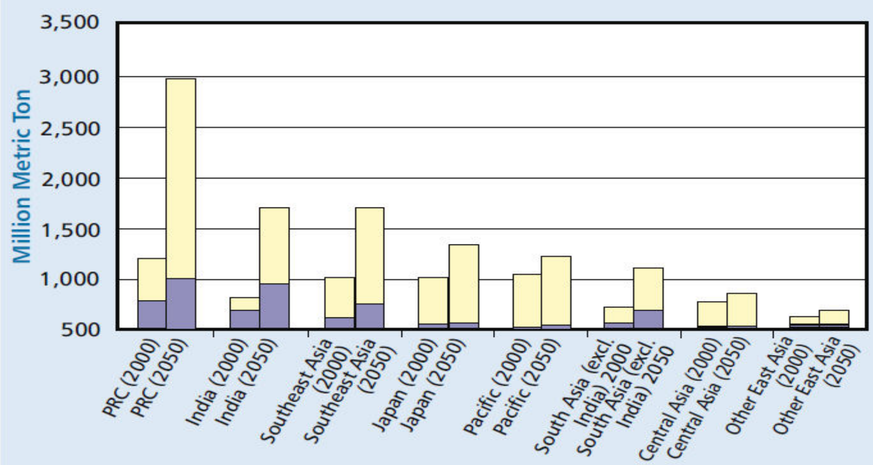
3. In closed-loop economy, nearly all outputs either become inputs to other manufacturing processes or are returned to natural systems as benign emissions rather than as pollutants, e.g., a closed-cycle processing plant takes in freshwater and does not discharge any liquid effluents. Rather, the water is constantly recycled and possibly utilized in the final product itself

However there are major policy gaps…

•Prevailing economic system does not provide adequate incentives for **<u>resource conservation and efficient resource allocation</u>**

•Prevailing production and consumption patterns are not adequately oriented towards **<u>resource efficiency</u>**, contributing to growing quantities of wastes that must be managed for final disposal

• For example, in Asia, as industrial economies continue to grow, the region will generate more toxic chemicals & hazardous wastes, mostly coming from industrial, agriculture, and manufacturing processes, but current waste management policies are not linked with resource conservation/ecosystem protection

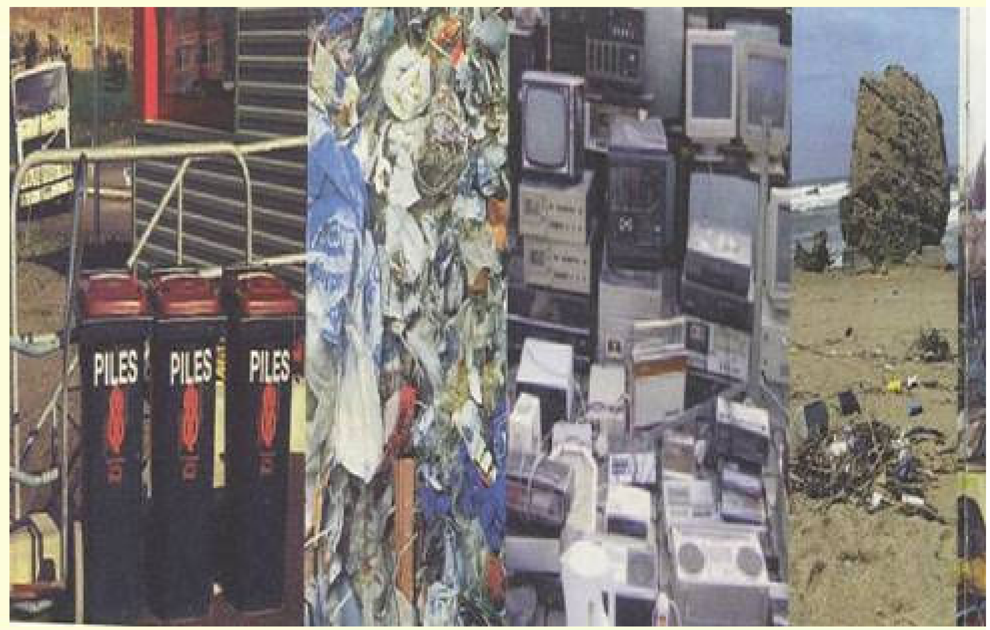


Projected Solid Waste Generation in Asia (2000-2050)

Industrial Solid Waste   Municipal Solid Waste

PRC = People's Republic of China.

Source: Solid Waste Projection Study by Tanaka et al.   Source: ADB & IGES, 2009



Conventional waste management

•Waste is traditionally thought of having no value! Focus is more on downstream or end-of-pipe solutions and local governments spend significant amount of money on waste collection & disposal without adequate consideration on resource saving measures and their economic return or input

where as up-stream solutions provide opportunities for –

- source reduction (increased resource efficiency/minimize raw material input)
- waste prevention/minimization of environmental risks through eco-friendly designs and products
- structured or reorganized production processes so that the waste of one industry is a valued input to another (industrial symbiosis)

Conventional waste management and the consequences

What we see…

- Limited efforts on reducing wastes at source
- Lack of segregation, poor collection, illegal dumping, open dumping and burning
- Limited involvement of private sector and communities
- Lack of integrated approach, and conventionally waste being thought of having no value
- Slums are deprived of municipal services

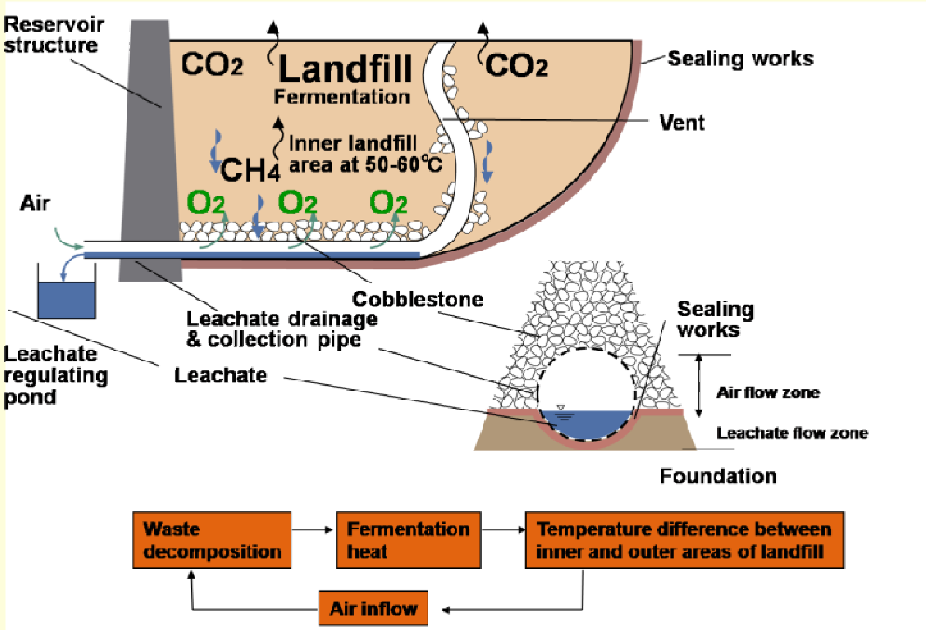
Photo courtesy: C. F. Kura, ITC38 Training Course Participant, UNCRD.

Photo courtesy: B. Paudel, ITC38 Training Course Participant, UNCRD.

Photo courtesy: C. Viengsan, ITC38 Training Course Participant, UNCRD.

Conventional waste management and the consequences

•Over reliance on conventional type waste management such as landfills and incineration is not sustainable (landfills are major source of methane (CH_4), a powerful GHG, and land costs are getting very high).



Source: Fukuoka University and Fukuoka City Government

GHG emissions from waste are directly affected by numerous policy & regulatory measures that encourage energy recovery from waste, restrict choice for ultimate waste disposal, waste prevention / minimization through 3R. In many countries, e.g., in EU & Japan, waste management policies are closely related to & integrated with climate policies.

What should be the priority for countries?

Product policy

versus

Waste Policy

(Preventive/up-stream solutions)

(Down-stream/end-of-pipe solutions)

What should be the priority for countries?

Waste prevention, extended use, re-use

versus

An expanded recycling industry

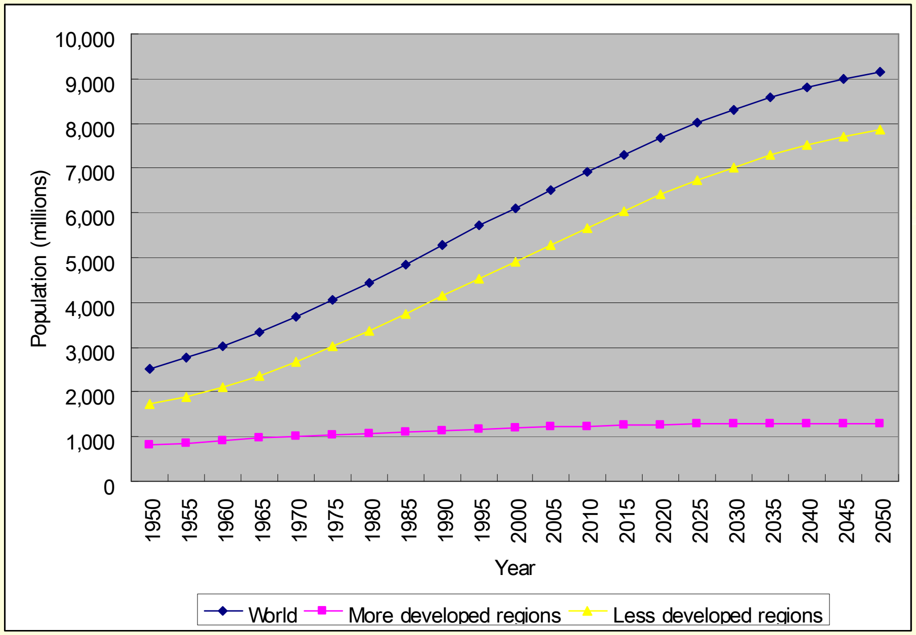
(Resource Conservation/Resource efficient economy & society)

(Resource intensive and hazardous production of expanding markets)

Selected World Trends on Human activities
– Population growth & urbanization

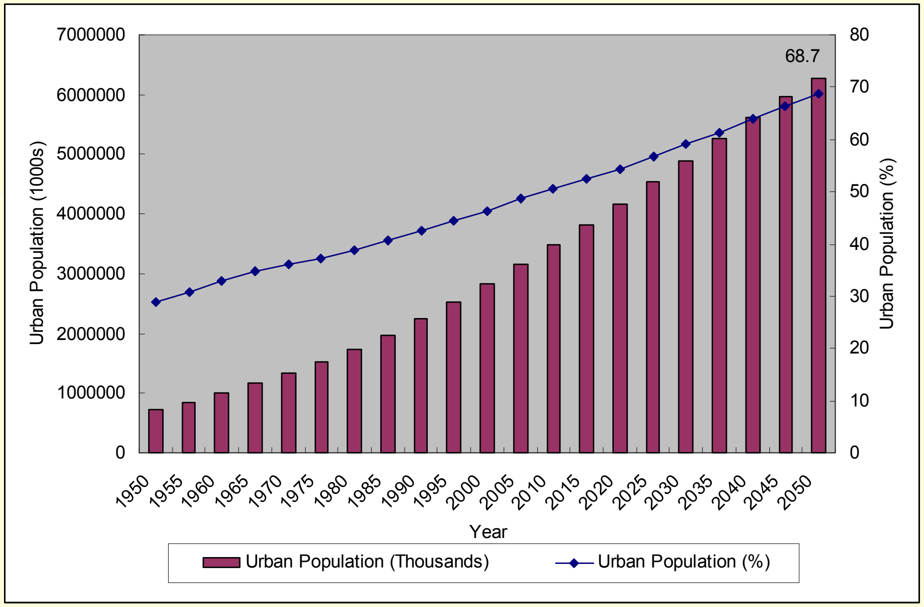
- **By 2050, world population is projected to reach 9.1 billion. 99 percent of global population growth is projected to occur in developing nations.**
- **By 2050, 68.7% of the world population is projected to live in urban areas.**

Population growth projection : 1950-2050



Source: Population Division of the Department of Economic and Social Affairs of the United Nations Secretariat, World Population Prospects: The 2008 Revision, http://esa.un.org/unpp

Projected urbanization : 1950-2050



Source: Population Division of the Department of Economic and Social Affairs of the United Nations Secretariat, World Population Prospects: The 2008 Revision and World Urbanization Prospects: The 2009 Revision, http://esa.un.org/wup2009/unup/

Selected World Trends on Human activities
- Production & Consumption, and Waste issues

Unsustainable pattern of production and consumption:

- Between 1960 and 1995, world use of minerals rose 2.5-fold, metals use increased 2.1-fold, wood products 2.3-fold, and synthetics, such as plastics, 5.6-fold.
- This growth of resource use outpaced the increase in global population.
- Mass consumption society correlates with a decline in health indicators in many countries.

Generation of wastes:

- Estimated quantity of waste collected worldwide is at between 2.5 and 4 billion metric tons.
- Estimated municipal waste collected world wide is 1.2 billion metric tons (2004).
- Global municipal waste generation in 2030 will be 900 million tonnes in OECD, 1 billion tonnes in BRIICS and 1.1 billion tonnes in ROW.

Photo courtesy: C. Viengsan, ITC38 Training Course Participant, UNCRD.

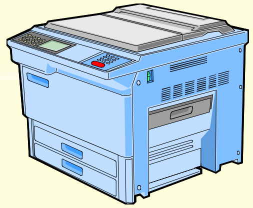
Source: Worldwatch Institute (2004), CyClOpe and Veolia Environmental Services (2006), and OECD (2010).

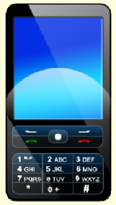
Diversification of wastes – Examples of E-waste

- Every year 20 to 50 million tonnes of e-waste are generated worldwide
- About 53 millions tons were produced worldwide in 2009 and only 13% of it was recycled
- By 2020 e-waste from old computers in South Africa and China will have jumped by 200-400% and by 500% in India from 2007 levels
- One billion PCs will be in use by the end of 2008 - two billion by 2015 with most growth in emerging Brazil, Russia, India, and China

Source: adapted from Sunil Herat (2010), Presented at the International Consultative Meeting on Expanding Waste Management Services in Developing Countries, 18-19 March 2010, Tokyo, Japan.

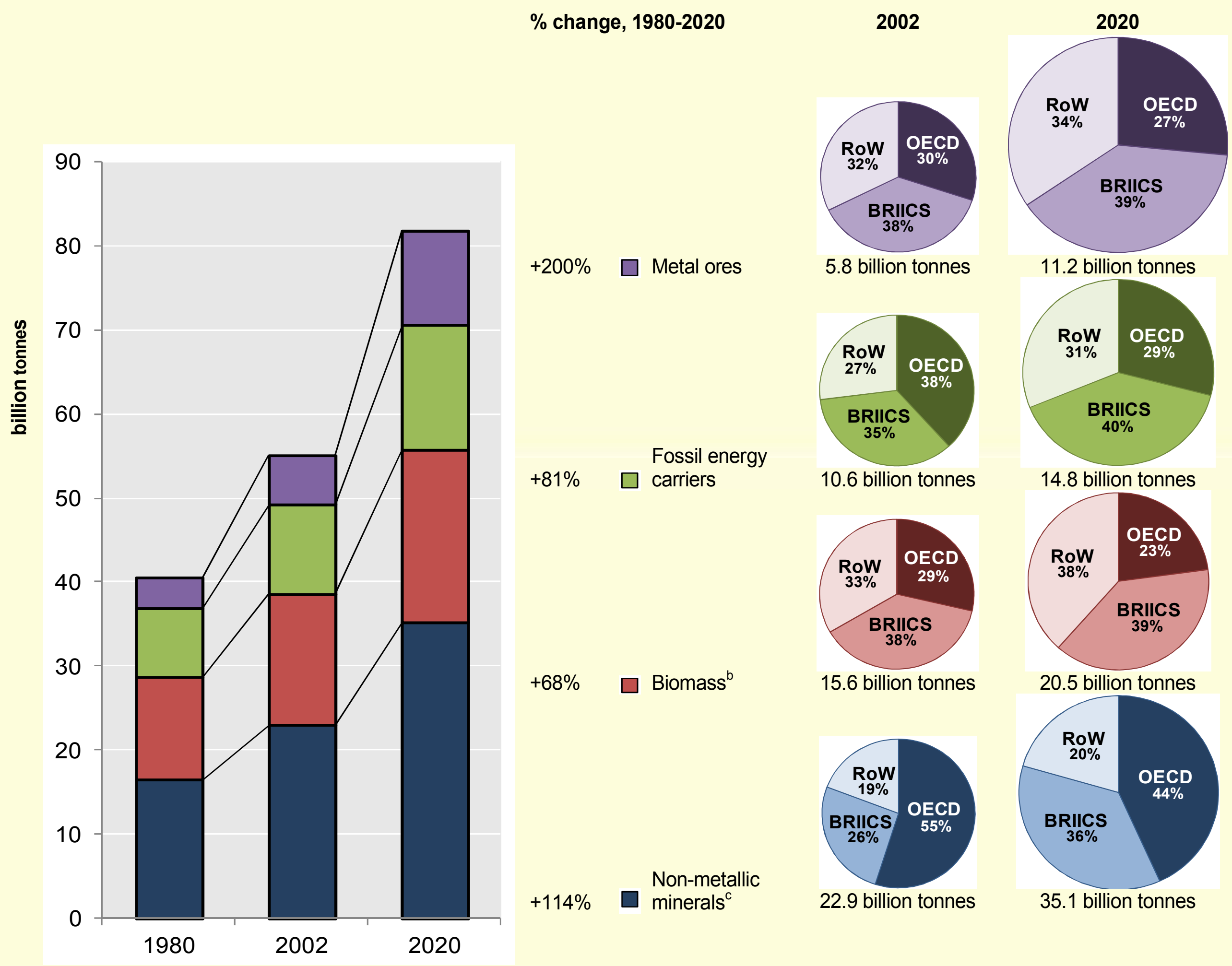
- Dangerous chemicals and metals, such as mercury, cadmium, lead, are included in e-wastes and may leach into the environment and local ecosystem.





Selected World Trends on Human activities – Resource Extraction

Global resource extraction, by major material groups and regions, 1980-2020



- **Annual resource extraction will increase to 80 billion tonnes in 2020 (~100 billion tonnes in 2030), up 48% from 2002.**
- **This growth will be uneven between different areas and categories; overall growth rates will be highest in BRIICS.**

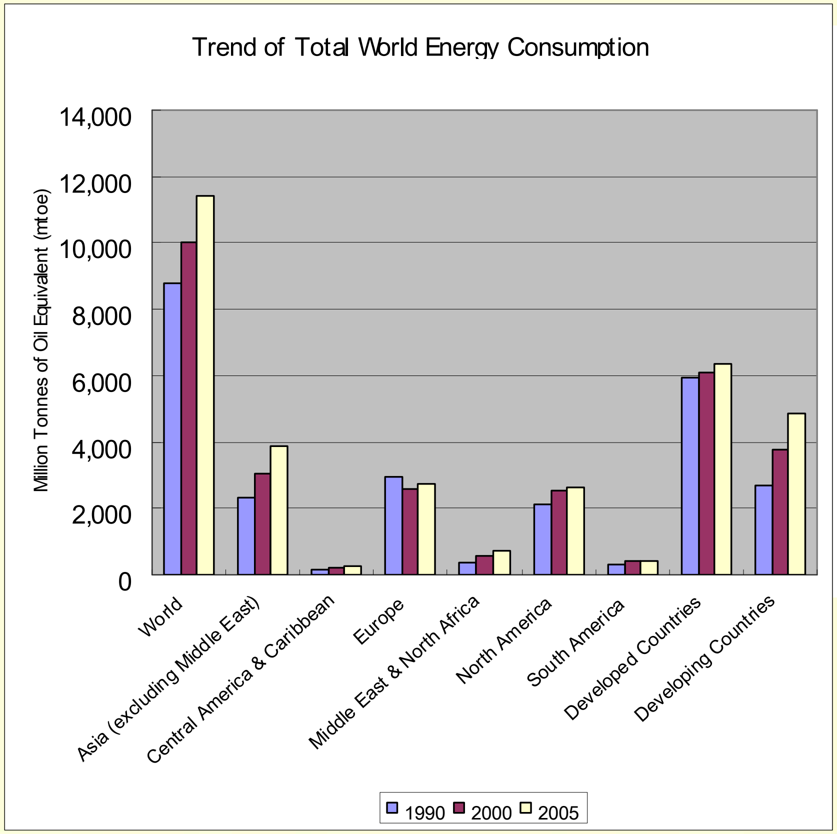
BRIICS: Brazil, Russia, India, Indonesia, China, and South Africa.
ROW: Rest of the world

Source: OECD (2010), presented at the Second Meeting of the Regional 3R Forum in Asia in October 2010 in Kuala Lumpur, Malaysia.

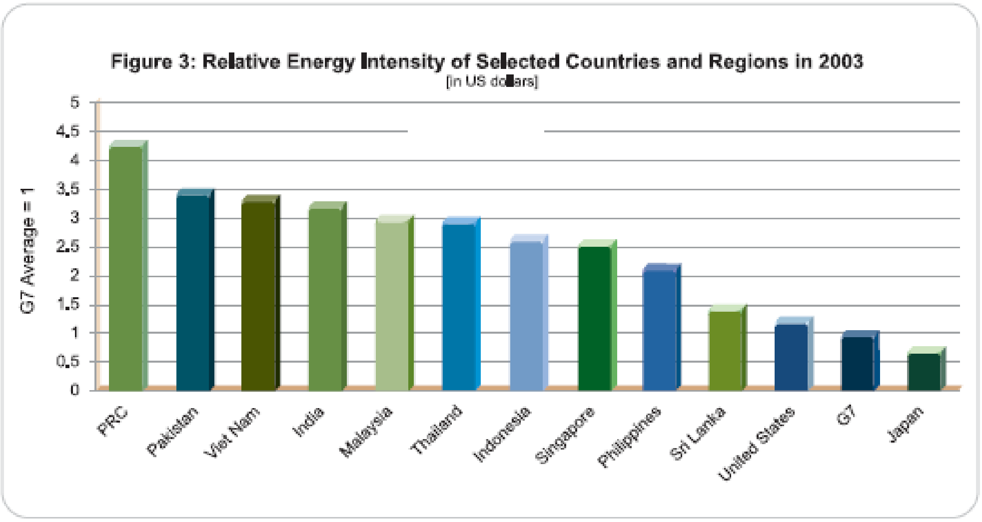
Selected World Trends on Human activities – Energy Use

- **Total world energy consumption grew from approx. 8,758 mtoe in 1990 to 11,434 mtoe in 2005; majority of the increase has been in developing countries.**
- **Meanwhile, energy conversion process remains inefficient in most developing countries.**

The Growing Demand for Energy



Relative Energy Intensity of Selected Countries and Regions



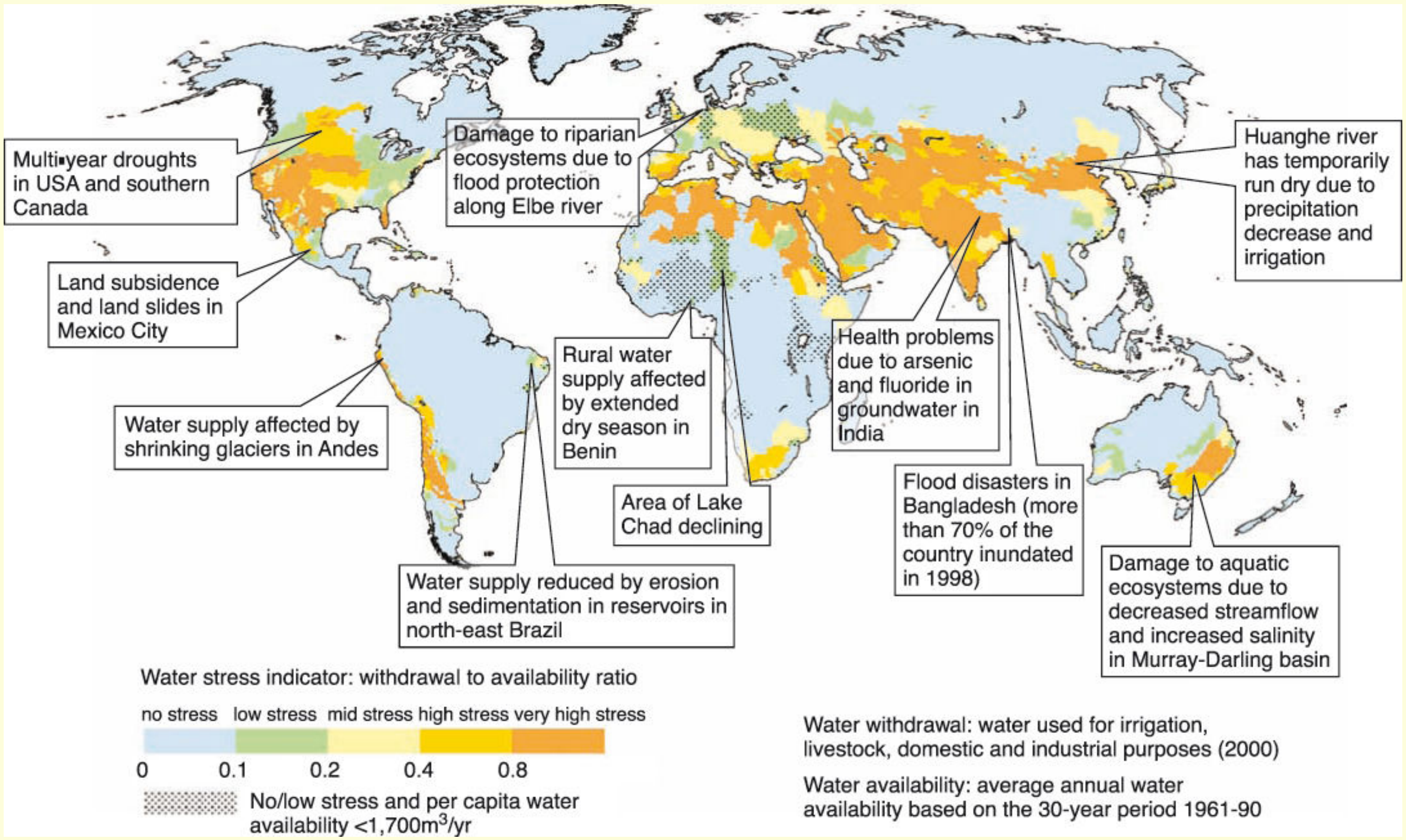
Energy intensity is energy consumption per unit of GDP

Source (above): ADB, 2006. *Toward a Cleaner Energy Future in Asia and the Pacific.*

Source (left): International Energy Agency (IEA) Statistics Division. 2006. Energy Balances of OECD Countries (2006 edition) and Energy Balances of Non-OECD Countries (2006 edition). Paris: IEA. Available at http://data.iea.org/ieastore/default.asp.

Selected World Trends on Human activities
- Degradation of water resources

By the year 2025, as much as two-thirds of the world population may be subject to moderate to high water stress.



Source: Water Stress Map generated by World Meteorological Organization 2008 based on data available at Alcamo *et al.* (2003)

Source: Modak (2010), presented at the Second Meeting of the Regional 3R Forum in Asia in October 2010 in Kuala Lumpur, Malaysia.

Poor waste management further compounds the water issue ..

Source: ADB (2004)

Highly contaminated leachate seeps untreated into groundwater, a source of drinking water….

Water availability is an emerging issue in Asia with some countries are already heading towards water stress, but water quality deterioration because of industrial discharges and municipal sewage, agrochemicals will further accelerate the issue!

Conventional waste management and the consequences .....

Health risks for informal sector workers, local communities living near dumpsites, etc.

How serious is the health risks of waste pickers, who most often operate without any protective measures?

- **hospital waste (HIV)**
- **jagged metal (tetanus)**
- **smoke (PCBs)**
- **lead (neural damage)**
- **violence (knife cuts)**
- **adult behaviour (premature drinking)**
- **stress**
- **skin, gastric, respiratory problems**

***Waste dumps potentially serve as breeding ground for Malaria, thus having implications in achieving MDGs*.**

Source: Adapted from ILO (2009), presented at the Inaugural Meeting of the Regional 3R Forum in Asia in November 2009 in Tokyo.

Informal Sector in 3Rs/Waste Management

Major opportunity for win-win solutions through partnership with informal sector

- Build recycling rates
- Move towards zero waste
- Improve livelihoods
- Improve working conditions
- Save the city money

Photo credits: Enrico Fabian (cited from Wilson, D.C. (2011)).

Global estimate of professional waste workers in the community / informal sector: 15 million

Informal sector recyclers are reported to comprise as much as 1 per cent of the world's population

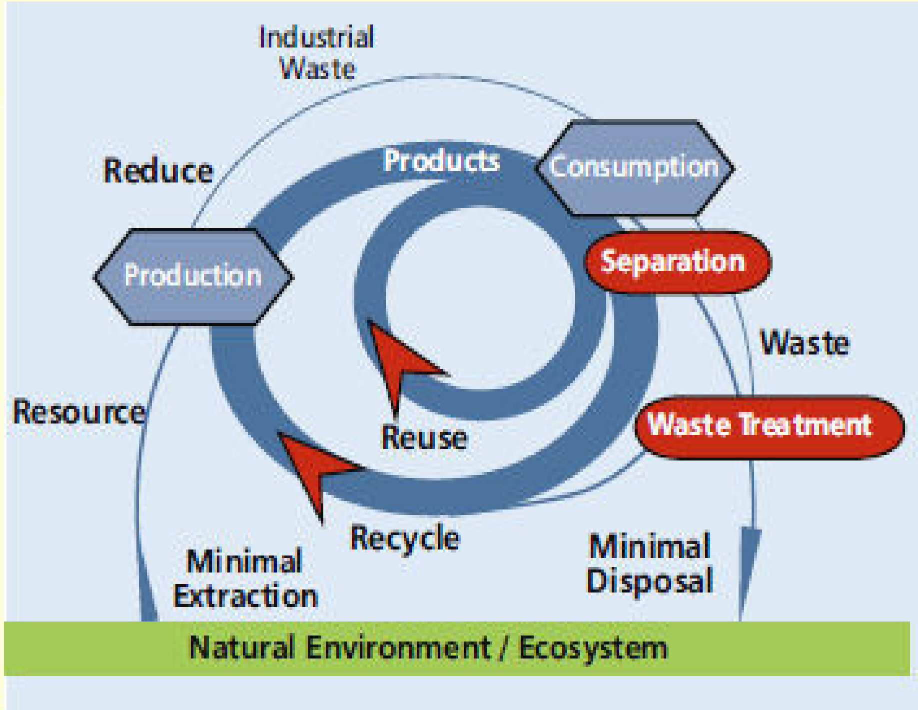
Source: Wilson, D.C. (2011), presented at the CSD Intersessional Conference on Building Partnerships for Moving towards Zero Waste, 16-18 February, Tokyo; and Scheinberg A, Wilson D.C. and Rodic L. (2010). Solid Waste Management in the World's Cities. Published for UN-Habitat by Earthscan, London.

Need for fundamental change in our mindset and attitudes to view "Waste" as "Resource"

- Link between "waste" and "resource" is not well understood.
- Too much emphasis on "downstream" waste management.
- Limited efforts on "upstream" resource management and waste reduction aspects

Examples of some good initiatives:

- Recycle Based Society/Sound Material-Cycle Society in Japan
- Green Growth in Korea Rep. of
- Circular Economy in China



Source: ADB and IGES (2008), p. 9, Figure 1.7.

Various types of waste and their recycling potentials

Type of waste	Recycled products	Recycling potential
Biomass	Composts	Future of compost depends on its environmental and agronomic quality and the dynamism of its market.
Paper and cardboard	Recovered paper (recycled paper)	Increasing demand in Asia, particularly in PRC.
Plastics	Recovered plastics	Increasingly stringent regulations and growing demand for recovered plastics in Asia, favoring development and internationalization of this market. Cost of collection system and volatile prices are limiting factors.
Ferrous Metals	Steel	In 2004, world production of scrap metal rose to 450Mt and consumption reached 405.5Mt. Can be recovered from MSW, construction waste, etc.
E-wastes	Recoverable materials	Estimated that 10million computers contain 135,000 metric tons of recoverable materials, such as base metals, silicon, glass, plastic, and precious metals.

Source: Extracted from ADB and IGES (2008) p. 125, with modifications.

Selected World Trends on Human activities – Resource Extraction: Scarcity of virgin materials

Estimated remaining resources:

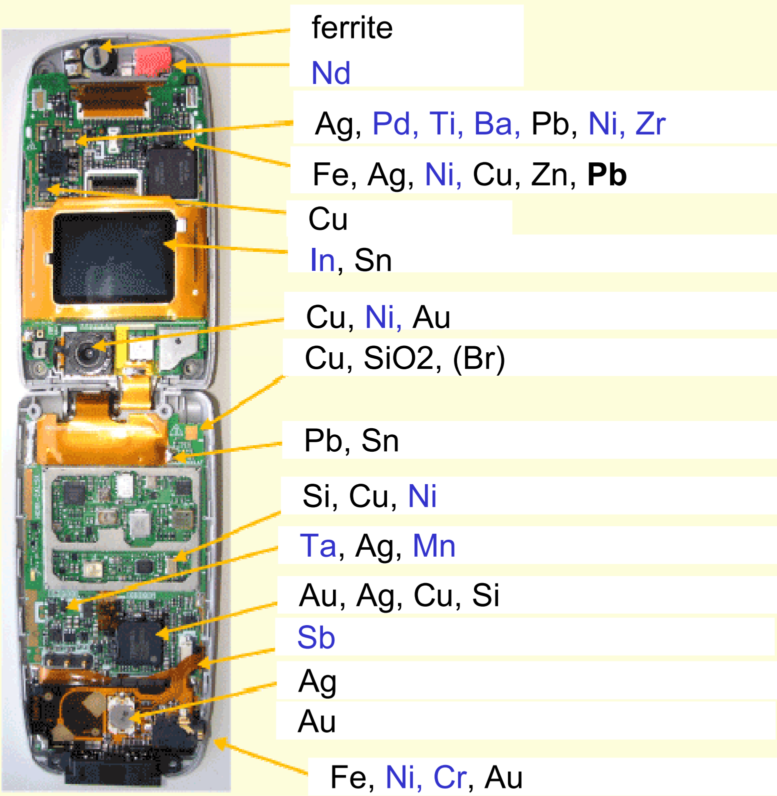
- Gold (Au): 20 years
- Copper (Cu): 34 years
- Iron (Fe): 70 years
- Nickel (Ni): 50 years
- Manganese (Mn): 56 years

Source: U.S. Geological Survey. Mineral Commodity Summaries 2010.

There is an urgent need to…

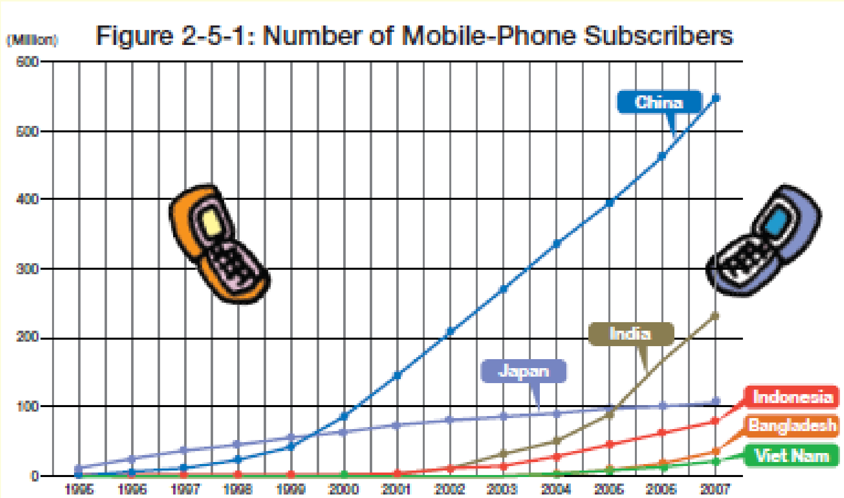
- **Reduce the intake of virgin materials in the production process.**
- **Increase the recycling rate and use "waste" as "resource".**
- **Improve resource efficiency.**

Mobile Phone contains over 50 chemical substances



Source: http://www.coden.jp/rare-metal/use.html

How many mobile phones are used in the world?



Source: 3R Source Book, UNCRD (to be published).

Mobile Phone Subscriptions in 2009

	In millions	*Per 100 inhabitants*
Brazil	174	89.8
Germany	105	127.8
India	525	43.8
Indonesia	159	69.2
Japan	115	90.4
Russia	231	163.6
USA	298	94.8

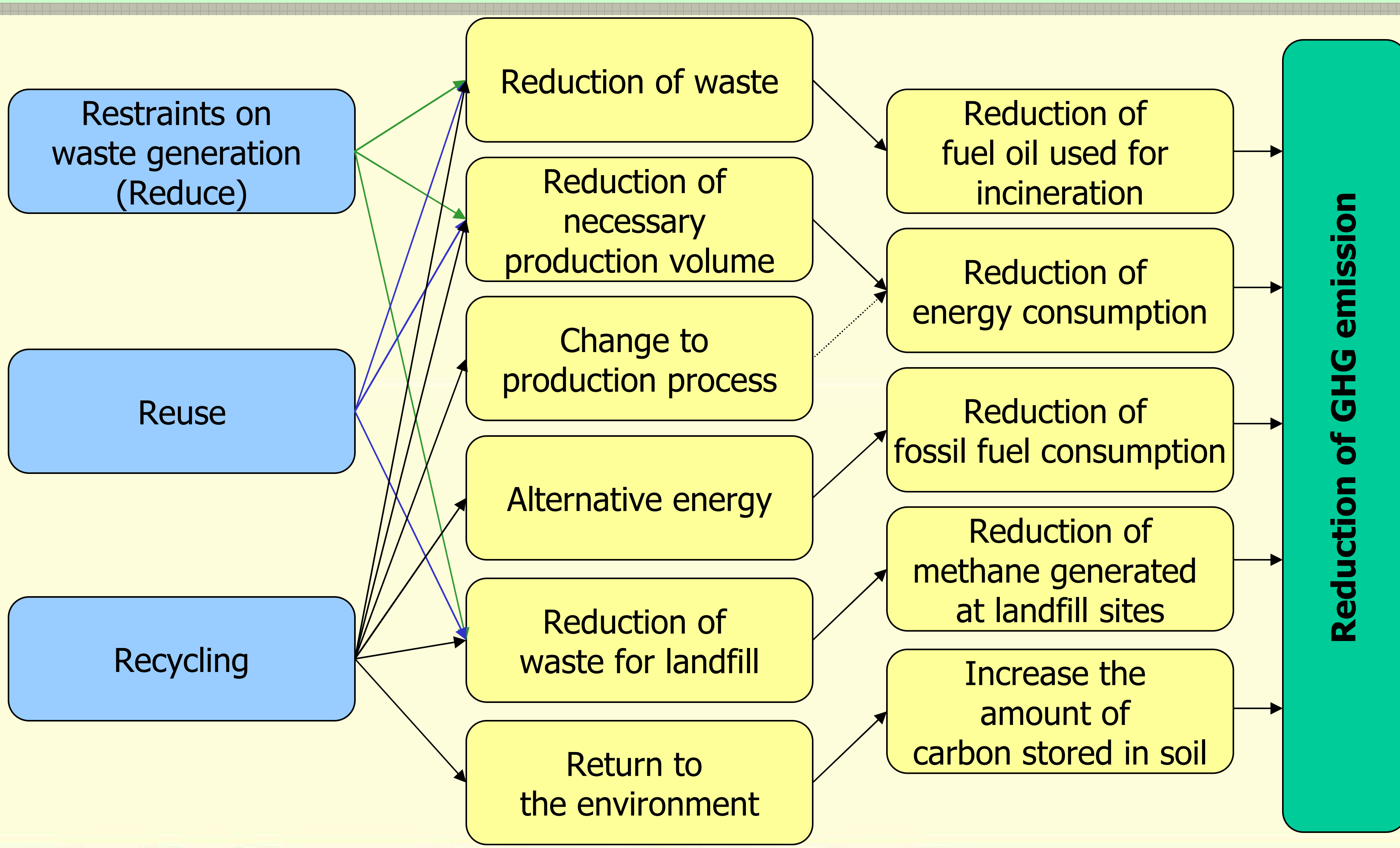
Source: International Telecommunication Union –BDT

What happens to old devices?

- **44 percent of mobile users simply left their old devices unused at homes, while 4 percent of old devices were thrown into landfills (The survey polled some 6,500 people in 13 countries, including China, India, and Germany).**

Source: http://www.nokia.com/environment/recycling/why-recycle/take-back-achievements,

The relation of reduction of the amount of waste disposal with the amount of greenhouse gas emission



Source: MOEJ, 2009

New Environmental Business Opportunities & 3Rs

"Going green**" can be profitable through the expanding market of environmental goods and services. Recycling market offers a competitive 'sink' as an alternative to increasingly expensive landfill, incineration, and other treatment options.**

Significant opportunities that exist for the private sectors could be divided in three categories:

Equipment & technology: water equipment and chemicals, air pollution control, instruments and information, waste management (waste minimization, resource recovery technology, etc), process / prevention technology.

Services: solid waste management, hazardous waste management, consulting and engineering, remediation and industrial, analytical services, water treatment services.

Resources: water utilities, resource recovery, environmental energy.

Source: adapted from ADB, 2005 & UN HABITAT, 2010

Landfills and Incineration versus Resource Recovery and Recycling

Problems with conventional waste management (Landfills and incineration)

- Waste disposal is expensive
    - Requires substantial inputs of labor, materials, energy, and land.
- Establishing new landfills and incineration facilities is difficult because of high land costs and "NIMBY" attitudes.
- Even the "modern" landfills with advanced systems could potentially face problems in a long term, as these technologies are not infallible.
- Landfills are major source of methane (GHG).

Benefits of integrated waste management (Resource recovery and recycling)

- Countries and cities should pay equal attention to upstream options to reduce waste for final disposal and to reuse and recycle valuable resources.
- Upstream options are almost always more costs effective than disposal.
- Segregation and composting does not create substantial GHG if done properly.

Photo courtesy: Waste Concern

Source: ADB and IGES (2008).

The governments should be clear in their strategy –

- Whether to continue with business-as-usual with 'more waste and more recycling' approach?

-OR-

- whether the goal is to encourage the producer to alter the design of the products?
- whether the goal is to utilize the expertise of the manufacturers in managing the used products after they attain end-of-life?
- whether the goal is to develop modalities for gradual shifting of the cost of managing the used products from municipalities to manufacturers (EMS, EPR, etc.)

Selected policies to improve/promote resource efficiency

Material efficiency:

• View wastes as valuable resource for jobs and economic opportunity.

•Develop law on waste management which should introduce and classify wastes and establish roles for public and private sector.

•Promote resource recovery firms, including collection, processing, reuse, remanufacturing.

Energy efficiency:

•Promote business opportunities such as renewable energy and energy efficiency firms, including solar, wind, bio-mass gas and fuel.

•Combine and streamline resource/energy efficiency policies with national policies and programmes on greenhouse gas emission reduction.

•Develop clear procedures that encourage private sector (both national and foreign) to invest in resource/energy efficient technologies and practices.

Water efficiency:

•Promote integrated water resource management, and allocate water, as basic human need, to its highest valued uses whenever feasible.

•Reduce pollution discharges to water bodies through appropriate policy, regulations, and technology solutions.

•Recycle grey water from households and promote rain water harvesting.

•Address water efficiency in agriculture, domestic, and industrial supply and consumption.

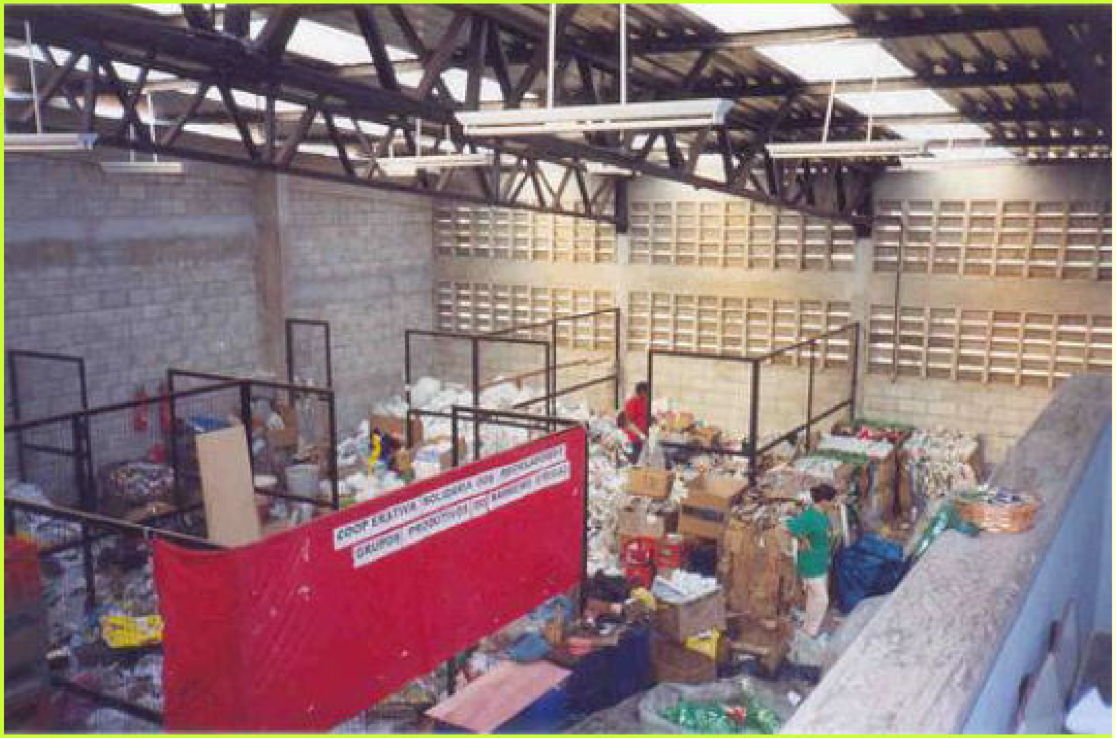
Greening Supply Chain: address not only the environmental practices of companies/industries, but also of their associated suppliers and vendors to ensure that the environmental standards they have adopted internally are consistently maintained/followed by their suppliers.

Industry code of practice: promote industry code of practice that provide broad guidelines to firms for a management approach that addresses issues of resource efficiency, thereby environmental sustainability, as part of core business decision making, e.g., Japanese manufacturers have established Japan Article Management Promotion Consortium (JAMP) to help them comply with chemical related regulations.

(Source: Adapted from ADB, 2008)

Integrate informal sector into sustainable waste management - Case from Brazil

- Waste-picking recognised as a profession (2001) – entitled to the minimum wage in negotiations with municipalities
- National Inter- Ministerial Committee for Social Inclusion of Waste Pickers (2003)
- Waste and Citizenship Forums – aim to eradicate open dumps, child labour & integrate waste pickers



Recycling facility of one of the waste picker cooperatives in Belo Horizonte © SLU

Source: Wilson, D.C. (2011), presented at the CSD Intersessional Conference on Building Partnerships for Moving towards Zero Waste, 16-18 February, Tokyo.

Selected quantitative indicators to assess resource Efficiency in an operation

- Ratio of virgin materials to total material inputs in the production process.
- Ratio of actual to potential recycled materials
- Ratio of renewable to fossil fuel sources.
- Materials productivity – the economic output per unit of material input
- Energy productivity - the economic output per unit of energy input
- Waste disposal per economic output - the economic output per unit of material disposed in sumps, landfills, incinerators.
- Resource input per unit of end-user service – the ratio assesses resource use against the useful function gained and maintained for the macroeconomic indicator, which is presented as the ratio of green GDP to the standard GDP.