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3R PRACTICES FOR MUNICIPAL SOLID WASTE MANAGEMENT IN ASIA

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ABSTRACT

Extraordinary emerging consumption statistics from the developing Asian countries has clearly indicated the increase waste generation over the past decades. Most of the developing Asian countries are experiencing solid waste management problem in terms of collection efficiency, disposal facilities, limited financial resources and weak policy interventions. Unlike developed nations, final disposal of solid waste in developing Asian countries is usually a matter of transporting the collected waste to the nearest available space for disposal. Moreover, sustainability of landfills has become a challenge in Asia due to various considerations such as availability of space, technologies for gas capture and leachate treatment, tropical climatic condition and waste characteristics. Plastic and paper wastes are dominating due to rapid economic development. Treating waste as a resource is the first step towards sustainable waste management and conserving resources. As for the biodegradable waste, feasible treatment technologies such as composting and anaerobic digestion with attractive results have been established. The non-biodegradable waste fractions are to be managed by implementing the 3Rs: Reduce, Reuse and Recycle. This article attempts to give a picture of the ongoing 3R implementation in urban municipal solid waste management in Asian countries. It was observed that in most of Asian countries, informal activities highly dominate due to lack of funding, government initiation, lapse in policy and public ignorance on waste management issues.

KEY WORDS

Municipal Solid Waste, Reduce, Reuse, Recycling, 3R, Technology Gaps

1 INTRODUCTION

Current paces of urbanization, consumerist societies and waste generation have challenged global sustainability in many ways. With the unplanned urbanizations and rapid growth of middle class families with changing lifestyles, most of the Asian countries are facing an enormous challenge of managing urban waste. Predictions on global waste generation levels are presented in *Figure 1.* A study conducted by the World Bank, reveals that urban areas in Asia generate about 760,000 tonnes of Municipal Solid Waste (MSW) or approximately 2.7 million m^3 per day; and in 2025 it

is expected to reach 1.8 million tonnes of waste or 5.2 million m^3 of waste per day [1]. According to Center for Science and Environment, India's "Down To Earth", urban India produces 120,000 tons of MSW each day [2]. Population growth along with the rapid urbanization and industrialization has created great pressure on the limited natural resources. Sustainable use and management of natural resources, therefore, have become the focus of national concern. The Ecological Footprint of the Asia-Pacific region has risen by more than 130% since 1961, now requiring 1.3 global hectares of biologically productive area per person [3]. From all these, it is evident that only 3R could play a major role in terms of managing the waste and conserving natural resources.

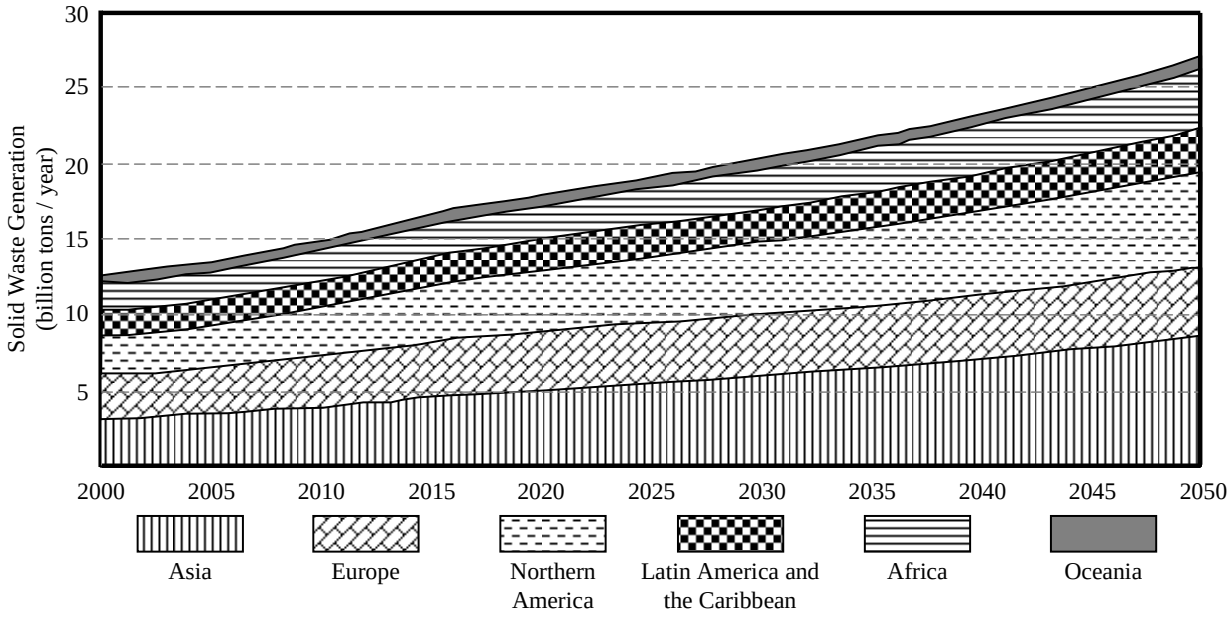

Figure 1. Predictions of global waste generation level
Source: [4]

In the past, managing solid waste was simply transporting waste to distant places for dumping. Only a fraction of waste was properly collected and transported. Sometimes they were burnt to reduce the volume, minimize attraction of animals and vermin and to retrieve recyclable items. However, these practices are being challenged due to the increasing value of land, inadequate space, and the limited carrying capacity of the environment, ultimately posing a threat to human health. Many countries in the Asian region have been facing looming waste crises with unsuitable technology and lack of manpower to effectively treat the generated waste. Although some governments have recently formulated and incorporated measures and cleaner production options to tackle the waste crisis, most of these have been implemented only in the national capital cities. In the recent years, 3R (Reduce, Reuse, Recycle) initiatives, replication of good practices and educational campaigns have been promoting the values of integrated waste management and resource consumption.

2 REDUCE, REUSE AND RECYCLE (3RS) IN ASIA

The “3R Initiative” was officially launched at the 3R Ministerial Conference hosted by the Government of Japan in April 2005, with an aim to promote global action on 3R. In March 2006, a Senior Officials Meeting on 3R was organized in Japan resulting in strong commitment of governments and other stakeholders to implement 3R at local, national, and regional level.

2.1 Current practices of 3Rs in Asia

Tackling solid waste issues in the developing countries could be one of the most complicated and cumbersome task. Without any formal source segregation and with minimum public participation, almost all of the waste ends up in one common container or in an open backyard. Resource recovery and recycling usually takes place in all components of the system predominantly by the informal sector "waste pickers" or by the solid waste management staff themselves for extra income. Collecting, sorting, trading and recycling of disposed materials provides income to hundreds of thousands of people and are usually conducted by these scavengers under labor-intensive and unhygienic ways irrespective of the toxicity. In rural and peri-urban areas, urban municipal wastes generate a steady income despite the risks involved in treating and down cycling them to other consumer products. Many of these people work parallel to the formal solid waste system but in an informal manner. Recovered and recyclable products then enter a chain of dealers or processing before they are finally sold to manufacturing enterprises. However, the services of rag pickers often go unnoticed and issues concerning their livelihood are unaddressed. It has been estimated that about 20 to 30% of the waste generated in the cities of Asia Pacific region, are recycled by the informal sector. For example, in Bangladesh the informal sector is responsible for recycling about 4 to 15% of the total solid waste generated [5]. The situation in industrialized countries is very different, since resource recovery is undertaken by the formal sector, driven by law and a general public concern.

Recently, the importance of recycling activities in reducing waste volume, recovering resources and its economic benefits is being acknowledged. Many NGOs and CBOs are actively working on 3R related issues, often in a decentralized manner failing to fit in the bigger picture due to lack of communication, networking and other factors. As of today, a long-standing practice and a complex networking of informal source separation and recycling of materials exists. In most cases, they were compelled to focus more on reusing and recycling of waste than on source reduction. Prioritizing the 3Rs among themselves may not promise a drastic change within a short period, but will reap a significant reward in the long run.

2.2 Status and technology gaps in 3R implementation

The composition of MSW differs for different countries and regions and plays a significant role in determining and designing an appropriate technology for treatment and allocating the space needed for treatment facilities. The MSW generated in most developing Asian countries is dominated by biodegradable organic fractions (above 40%) with the moisture content more than 50% [6]. *Figure 2* presents the waste composition in the municipal solid waste of some Asian countries. The waste components are, in most cases, discarded or dumped without any treatment or recycling.

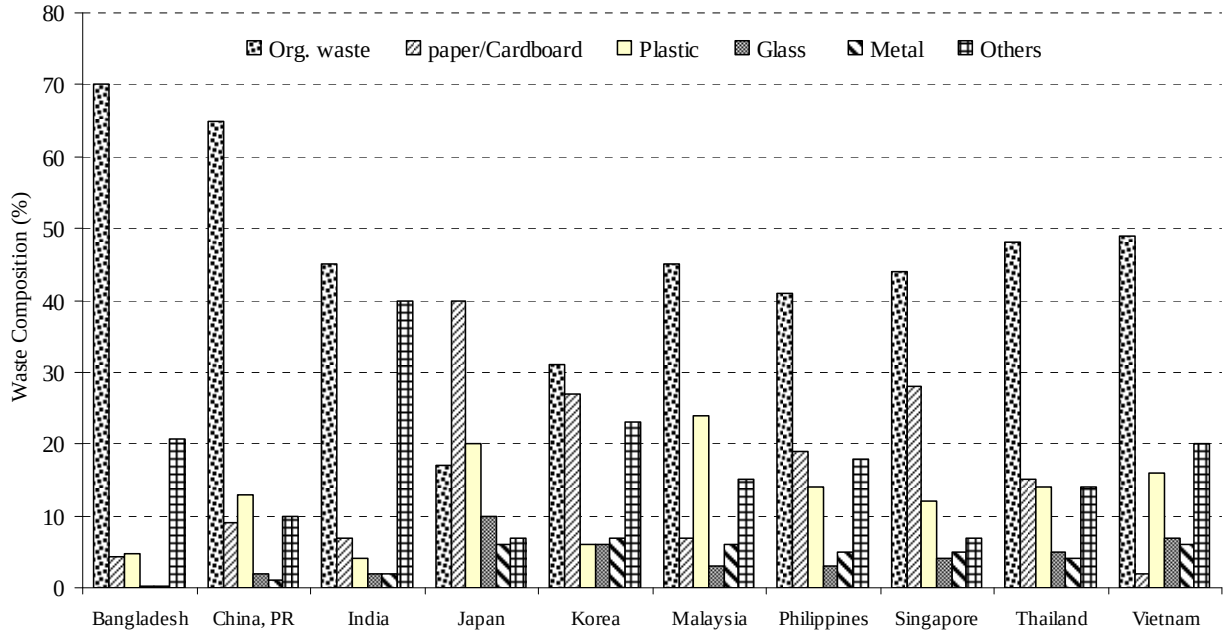

Figure 2. Composition of municipal solid waste in some Asian countries

Most of the developing Asian countries are in a budding stage when it comes to implementing 3R technologies. Such practices have been prompted by some private sector and NGOs to initiate recycling and proper waste management strategies. Waste Concern, an NGO in Dhaka, Bangladesh, for instance, has been actively involved in promoting 3R initiatives. Bangladesh has set an ideal example in successfully setting up decentralized composting systems throughout the country. Similar formal approaches are also observed in China, India and Thailand; but they still lack the basic support to make it strong and successful.

Technology applications for thermal recovery (direct combustion of waste to recover heat) and fuel recovery (RDF and PDF production from waste) are not observed in most of the Asian countries. These technologies are found to have been best applied only in the developed Asian countries. It was noticed that in China and Thailand, these technologies do exist but with an uncertainty in their efficiency both in terms of cost and environmental factors. Material recovery and sorting in MSW remains largely unexplored in many Asian countries. Although some pilot models have proved successful in developed countries, many details are yet to be determined in terms of implementation necessitating further research. *Table 1 and 2* present the status and technology gaps in 3R implementation in developing and developed Asian countries, respectively. In developing countries, a chain of informal recyclers, from waste scavengers to the waste dealers, perform the task of material recovery and sorting. It is justifiable to state that their livelihood could be at stake provided such technologies are operational and commercially successful, which practically is not likely to happen at least in the coming years. Nevertheless, pondering upon the health risks and the resource conservation, these providing technologies or at least some formal registration and support from the governments is vital. It is undeniable that

major focus should be paid to the 3R technologies associated with MSW sorting, pulverization and composting.

Table 1. Status and technology gaps in 3R implementation in developing Asian countries

Technology	Bangladesh	Bhutan	Cambodia	India	Indonesia	Malaysia	Philippines	China	Thailand	Vietnam
Thermal Recovery	⭘	☒	☒	⭘	☒	●	⭘	⭘	⭘	☒
Fuel Recovery	⭘	☒	☒	⭘	☒	●	⭘	⭘	⭘	☒
Material Recovery	⭘	☒	○	⊙	○	⭘	○	○	⭘	○
Sorting	○	⊙	○	⊙	○	☒	☒	○	☒	○
Pulverizing	⭘	☒	○	⊙	☒	☒	☒	⊙	☒	○
Composting	●	☒	☒	⭘	○	☒	☒	⭘	○	⭘
Incineration	⊙	☒	☒	⭘	⊙	●	⊙	●	⭘	⊙
Collection	⊙	⊙	⊙	○	⊙	⭘	○	⭘	⭘	○

Table 2. Status and technology gaps in 3R implementation in developed Asian countries

	Reduce	Status	Reuse	Status	Recycle	Status
Japan	Resource Conservation	●	Easier Disassembly	●	Thermal Recovery	●
	Product Lifetime Extension	●	Remaining Life Assessment	●	Fuel Recovery	●
	Waste Reduction	●			Material Recovery	⭘
					Sorting	⭘
					Pulverizing	⭘
					Composting	⭘
Korea	Resource Conservation	●	Easier Disassembly	●	Thermal Recovery	●
	Product Lifetime Extension	●	Remaining Life Assessment	⭘	Fuel Recovery	●
	Waste Reduction	●			Material Recovery	⭘
					Sorting	☒
					Pulverizing	☒
					Composting	☒
Singapore	Resource Conservation	●	Easier Disassembly	●	Thermal Recovery	●
	Product Lifetime Extension	□	Remaining Life Assessment	□	Fuel Recovery	●
	Waste Reduction	●			Material Recovery	⭘
					Sorting	☒
					Pulverizing	☒
					Composting	☒

Note on legends in Table 1 & 2

● Formal, Strong ⊙ Informal, Weak ☒Technology Gap
⭘ Formal but weak ○ Informal but Strong ☐ No information

- Formal and Informal denote the presence of regulations, laws and rules to govern an activity
- Strong and Weak represent the level and scale of a particular activity
- Where no law or rule exists and the practice is totally absent, it is denoted to be a gap.

3 LEGISLATIONS AND POLICIES

It is a very common practice in developing countries for people to dispose their waste openly or in an abandoned site. Environmental Legislations and Policies do exist in some form to protect their natural resources and environment, but most of them are not revised or updated according to the need and prevailing situation. In most cases, they do not create complications for the implementing body, but result in duplication of task and negligence in other activities. In cases, where they do exist, its implementation fails. The possible reasons for poor implementation could be a combination of social, technical, institutional and financial issues. Awareness, political will and public participation are essential for the successful implementation of the legal provisions.

Many Asian countries have recently made progress on the legislative front and share common interest in tackling solid waste issues. Perhaps, most noteworthy is India's recent review and finalization of the National Environmental Policy which place due stress on the adoption of cleaner technologies, strengthening the informal sector in collection and recycling of various materials. Recycled Plastics Manufacture and Usage Rules, 1999 was amended in 2003 and the Rules are applicable in all the States and Union Territories. In addition, strict enforcement is being ensured through the state authorities [7].

Several 3R initiatives such as Circular Economy in China, 5Rs policy in Indonesia and Zero Waste Society in Japan and Singapore have been implemented. Japan, Korea, Singapore, Taiwan and Hong Kong have made great strides in 3R implementation. For example, in Japan, the final disposal of waste has reduced drastically and the recycling rate has gone up because of various 3R legislations. Existing legislations, polices and acts in some Asian countries is presented in *(Table 3).*

Table 3. Waste management related policies and legislations in some Asian countries

Country	Laws, Policies & Acts
Bangladesh	Urban Solid Waste Management Handling Rules of Bangladesh' (under preparation), Ban on Plastic carry bags
Bhutan	Environmental Codes of Practice for Solid Waste Management
China	Circular economy policy is incorporated in China's eleventh 5-year national development plan. Cleaner production and waste management integrated into legislation
India	National Environmental Policy 2005, which incorporates the 3R concept, is currently under consideration
Indonesia	Pre-Inception meetings for the Formulation of National 3R Strategy for Indonesia conducted in September. 2006 organized by Ministry of Environment-Indonesia, UNCRD, and IGES

Japan	Amendments of the 'Containers and Packaging Recycling Law'
Rep. of Korea	Volume based waste collection. EPR implemented with mandatory targets for product recovery and recycling, regulations for promoting recycling of construction waste, reduction of food waste
Malaysia	The National Recycling Program 2000 launched in the year 2000. The National Strategic Plan for Solid Waste Management 2005 is currently being finalized
Nepal	Local Self Governance Act, 1999
Pakistan	No national quality standard for MSW, National Environmental Policy, 2005
Philippines	The Ecological Solid Waste Management Act
Singapore	The National Recycling Program launched in 2000, Zero Landfill and Zero Waste Strategy. The National Environment Agency (NEA) has signed the first Singapore Packaging Agreement (June, 2007) with five industry associations for a period of five years
Sri Lanka	National Strategy for Solid Waste Management
Thailand	National Integrated Waste Management Plan.
Vietnam	The Law on Environmental Protection, The National Strategy for Environmental Protection. The National 3R Strategy is being developed in collaboration with JICA, UNCRD, IGES, Ministry of Environment of Japan and ADB

Source: [8, 9]

4 FUTURE PROSPECTS OF 3R ACTIVITIES ENHANCING WASTE MANAGEMENT

In the race towards urbanization, many developing countries have witnessed the overflow of waste and depletion of natural resources at an alarming rate. Governments are becoming more aware of polluting sectors, and many NGOs and private organizations have been raising their voices against violations. One recent example is the failed recycling project of French War ship Clemenceau at the Alang shipyard in Gujarat, India.

With huge investment demands from Asia's expanding cities for infrastructure investments, it will require special attention to promote various positive practices and implement new activities. Emphasis should also be laid on developing policy and mechanisms to promote 3R activities at the community and institutional level and integrating locally-tailored solid waste management systems based on upstream waste minimization and sound downstream disposal, emphasizing strong community participation throughout**.**

4.1 Promoting Green Procurement

New government regulations in Japan and the Republic of Korea require the adoption of green procurement practices, which will serve as models for other countries in Asia and the Pacific. Japan has enacted a law on the Promotion of Procurement of Eco-friendly Goods and Services by the State and Other Entities. Each ministry and agency is required to track annual purchases and report them to the Ministry of Environment. The law also requires manufacturers or service providers to provide information on the environmental impacts of items they sell. In addition, a Basic Policy on Green Purchasing was released in March 2004. About 45 types of eco-friendly goods and services are specified in the Basic Policy with procurement target guidelines for each.

Similarly, The Republic of Korea introduced similar mandatory green procurement for 20,000 public institutions in 2005. The Green Purchasing Law adopted in December 2004 and enforced in 2005 obligated public agencies to purchase environmentally friendly products or Eco-Products.

The Thai Green Purchasing Network founded in 2004 under the Greening the Supply Chain Model of the Thailand Environment Institute defines concepts and definitions of Green Purchasing and Procurement and Green Product in Thailand. Besides organizing information exchange forums among members and other organizations, it also provides guidelines about Green Purchasing procedure best practices [10].

4.2 Awareness activities - knowledge management

Although production and consumption is rising, awareness of citizens, corporations and governments is still low towards waste issues. Many stakeholders are involved in working toward a recycling-based society, and all are needed to participate in overcoming the sheer inertia of resistance to change. Therefore, it is important to enhance public awareness of 3R issues by coordinated action through environmental education and dissemination of information on successful inter-stakeholder partnerships. *Figure 3* shows the awareness activities on packaging waste – Tetra Pak, Vietnam.

Figure 3. Packaging waste awareness - Tetra Pak, Vietnam
Source: [9]

4.3 Promoting a circular economy

The concept of Circular Economy (CE) should be promoted in Asian countries not only to resolve the waste issue but also to conserve its natural resources. Developed Asian countries like Japan, China and Korea are moving forward successfully in this concept. There are a number of ways to define the term Circular Economy. The accepted working definition may be interlinked to manufacturing and service businesses seeking the enhancement of economy and environmental performance through collaboration in managing environmental and resource issues. The theme of the CE concept is the exchange of materials where one facility's waste, including energy, water, materials as well as information is another facility's input. The new terms that are widely relevant are Eco-Industrial Networking and Industrial Symbiosis. These activities, if exercised correctly,

could prove to be a stepping-stone towards sustainable Asian cities and possibly the best gift for our future citizens.

4.4 Creating regional recycling centers

An analysis of the present situation of waste management and the status of 3R-oriented activities has clearly indicated that recycling is often practiced in a decentralized and informal manner. Recycling activities in the developed countries, practiced in a formal manner with necessary policy, legislative and institutional support has proven to be successful. In view of this and the current situation, two possibilities arise for promoting recycling in a formalized manner. One is the promotion of regional recycling zones and second is the transfer of technology from developed to developing countries. This could eventually, be done by following an approach that first enables the creation of conducive policies and investment environment followed by regional inter-linking of the recycling zones. An inevitable component of this approach is technology transfer. International cooperation between countries, irrespective of the economic status, is essential to achieve success at a regional scale.

5 CONCLUSIONS

An overview of the current practices of waste management indicates that

- Recycling is predominantly in the informal sector and uses primitive technology
- Very little instances of promoting formal, 3R-based solutions for waste crisis exist
- Specific policies emphasizing the need for 3R are very rare in Asian countries with exceptions of some developed nations in the region.
- Technology transfer and policy reformulation are essential to promote 3Rs
- Creating linkages between the recycling zones of countries is indispensable
- Cooperative and concerted efforts between and within countries are the need of the hour to promote a 3R-based economy.

Existing technology practices are not found to be sufficient to overcome the burden of waste in a sustainable manner. Simple technologies for 3Rs have to be made formal and strong by promoting new policies, reformulation of existing policies, cooperative efforts and technology transfer. Thus, the technologies chosen for waste management have to be tested for their sustainability, in addition to being environmentally effective, economically affordable and socially acceptable. Thus filling the gaps with such design is highly indispensable to move towards 3R as a means of solving the waste management problems.

As far as the implementation of 3Rs is concerned, Reduce and Reuse highly involves changes in human attitudes towards production and consumption patterns. This change has to begin at the grassroots with the commitment of all citizens of a country.

Recycling, which often takes place outside the purview of the consumer, depends largely on the technology base of the country. Developing and transferring appropriate, proven technologies forms a key component in successfully promoting recycling.

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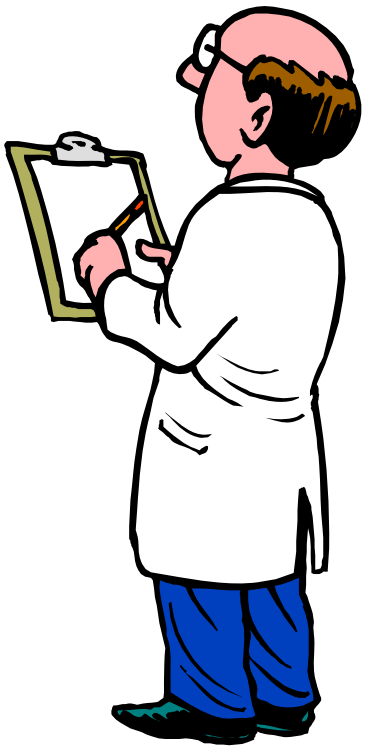
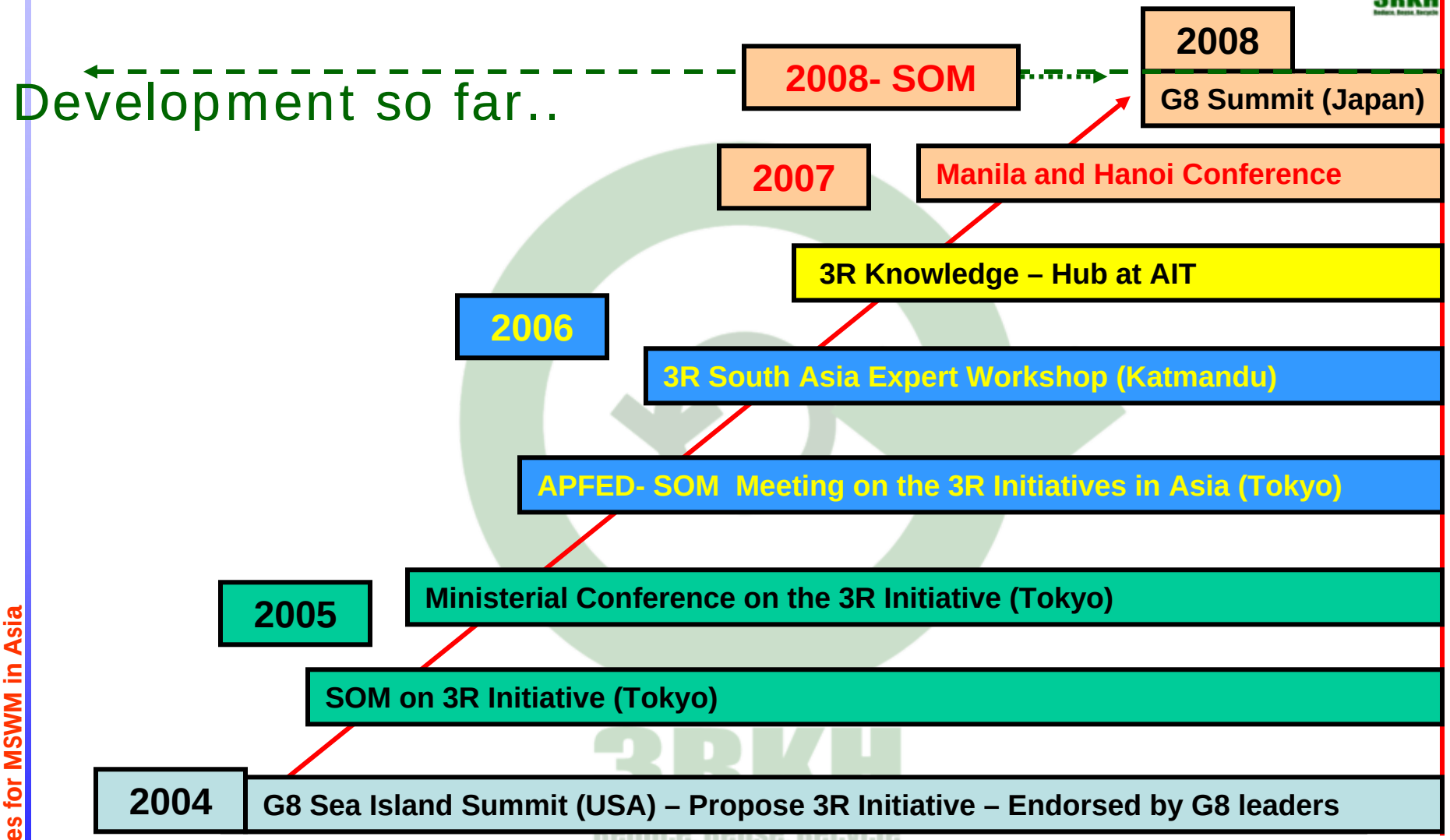
Contents of Presentation

- 3R Initiatives in Asia
- Sound Material-Cycle Society
- Prevailing Waste Management
- 3R Developments in Asia
- Gap Analysis- 3R
- Future Prospects of 3R Activities
- Conclusions



3R Initiatives in Asia



SOM: Senior Official Meeting

APFED: Asia Pacific Forum for Environment and Development

3R Initiatives in Asia

Global 3R Initiative

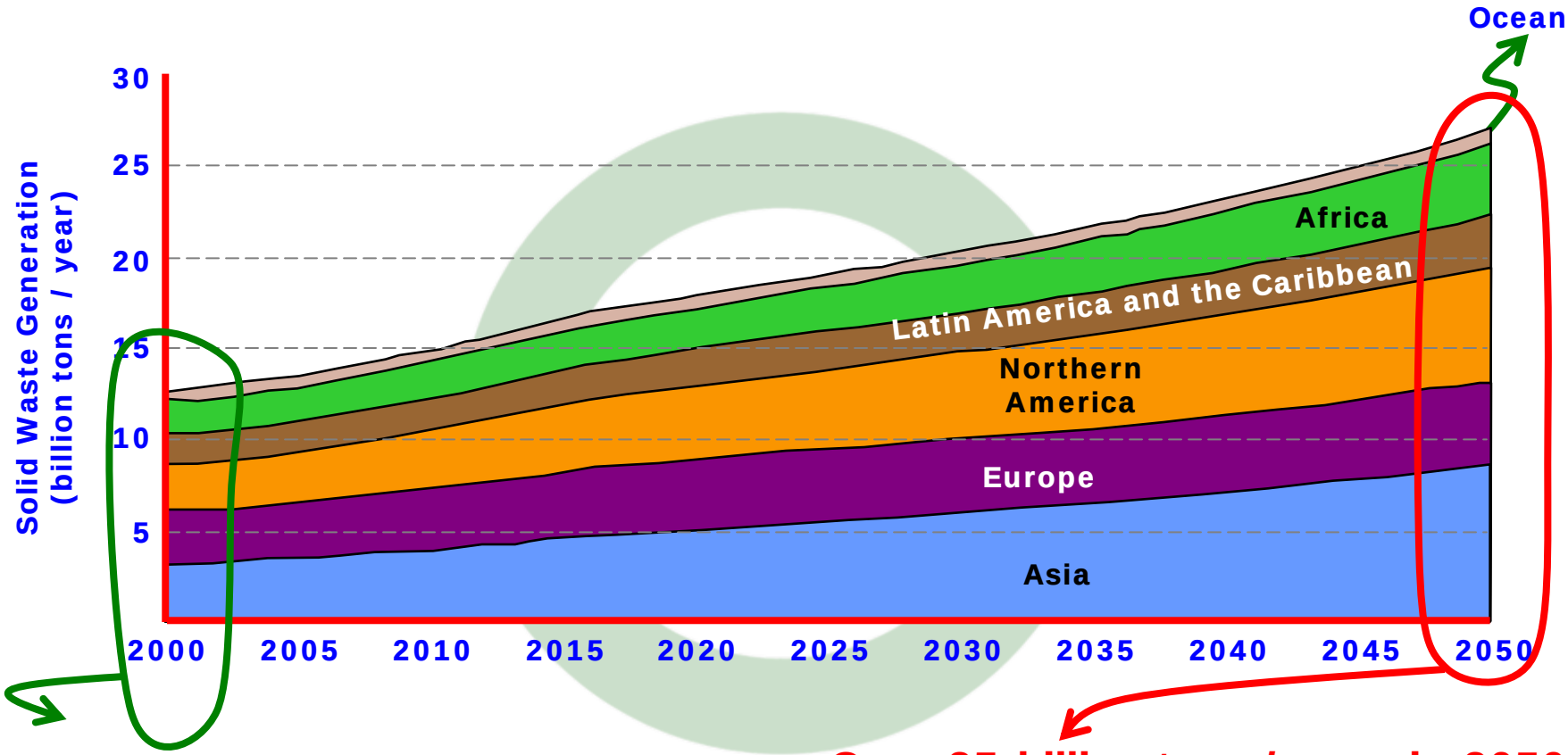
- Aims to promote the "3Rs" (reduce, reuse and recycle) globally so as to build a **sound material-cycle society** through the effective use of resources and materials.
- It was agreed upon at the G8 Sea Island Summit in June 2004 as a new G8 initiative.

UN Millennium Development Goal and 3R

MDG-7. Ensure Environmental Sustainability……why?

- Prevalence of unsustainable production and rapid consumption of virgin raw materials/natural resources
- Effective and efficient 3R programmes are vital to reverse these trends of environmental unsustainability.

Business As Usual – Waste Generations



12.5 billion tons / year in 2000

Over 25 billion tons / year in 2050

We will be doubling our waste generation in 50 years time…

How are we going to tackle the issue…?

Source : Yoshizawa, Tanaka et al. Research on estimation of world waste generation amount and future prospects

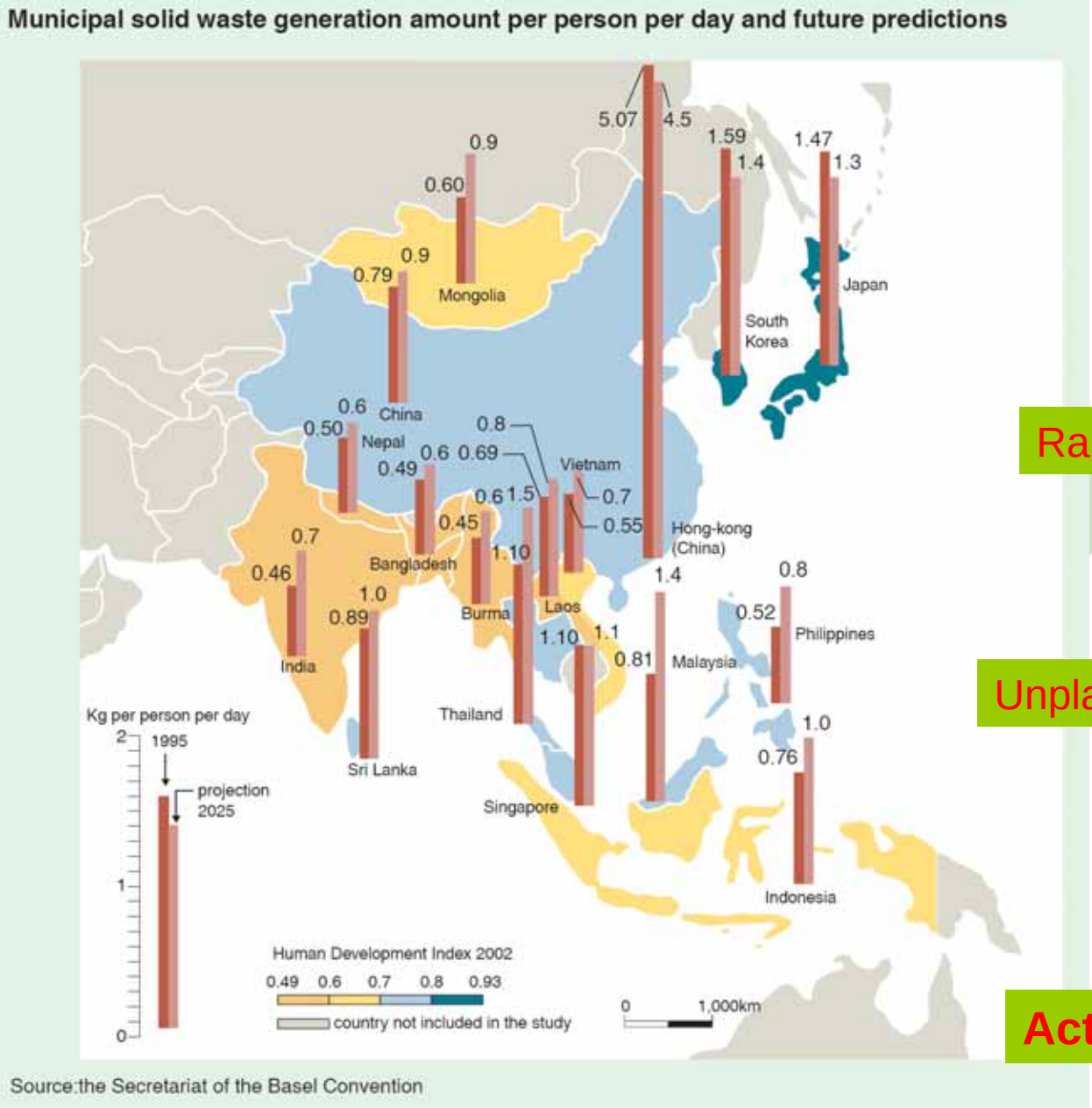
3R Initiatives in Asia

Why Asia?

Key Trends in Asia

- Rapid economic growth (China & India)
- Increasing quantity of solid waste, in the year 2002, China generated about 945 Million tons of Industrial Solid Waste and 136.5 Million tons of MSW are collected from urban centers
- Accounts for more than 60% of the world's human population
- Diversified composition of solid waste
- Trans-boundary movement of 3R-related goods, materials and products
- Rising price of material resources

MSW Generation & Prediction in Asia

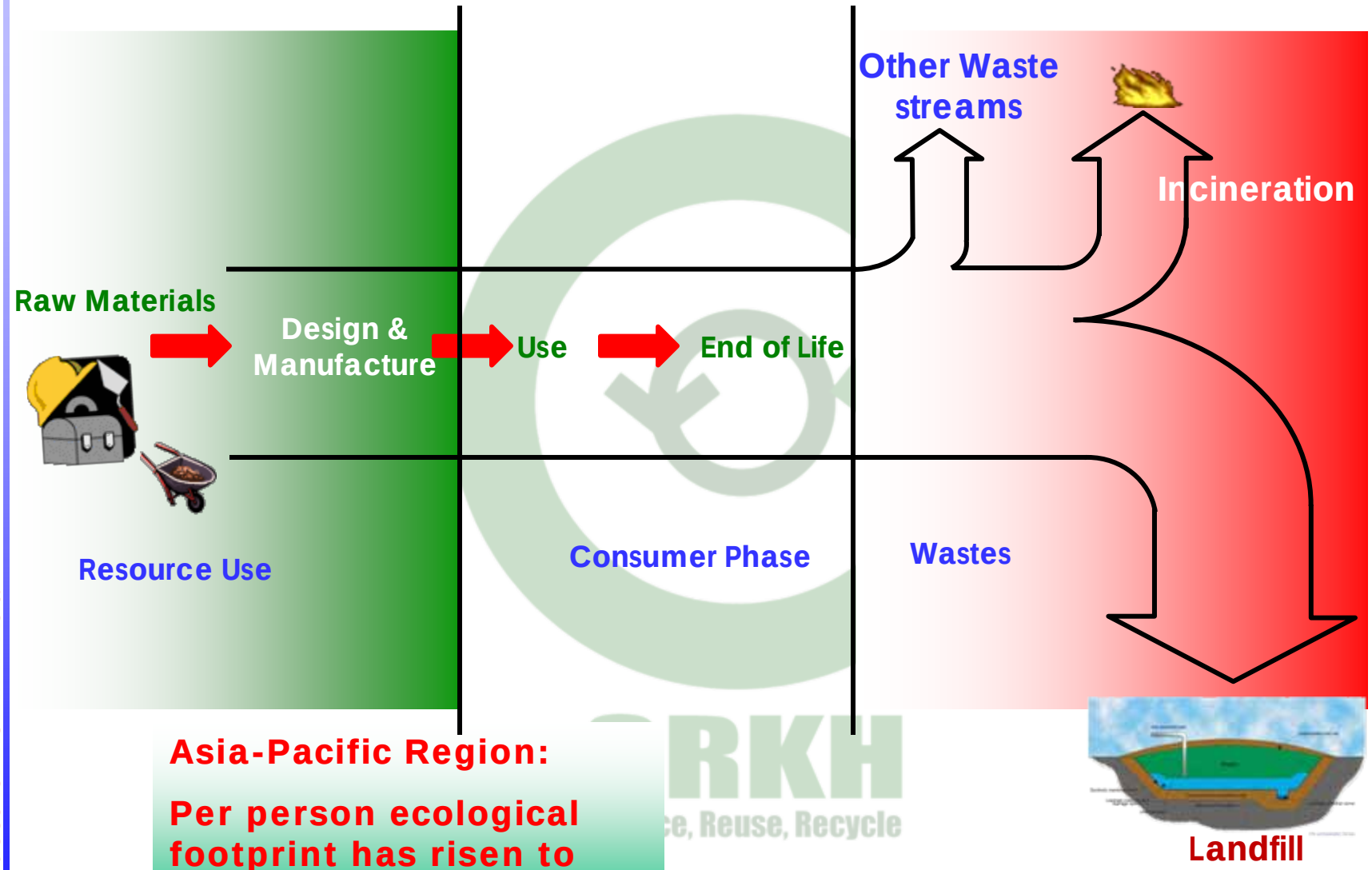


Rapid Economic Growth

Unplanned Urbanization

Act Now – Think Later

Material Society



Asia-Pacific Region:

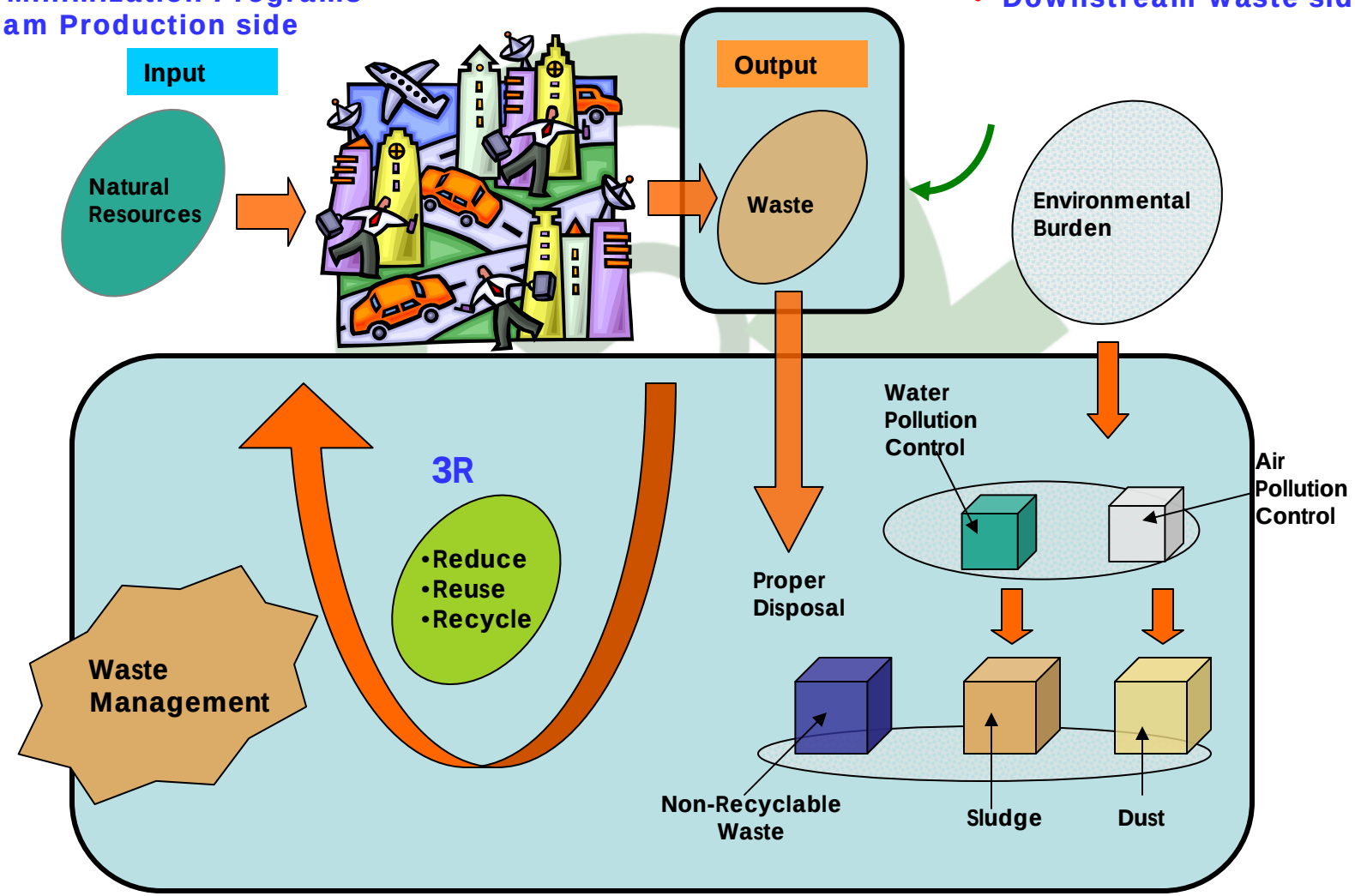
Per person ecological footprint has risen to 130% since 1961…!!

Resource Use and Waste in a Society

European Union
- Cleaner Production
- Waste Minimization Programs
- Upstream Production side

Japan
- Post consumer
- End-of-life products
- Downstream waste side

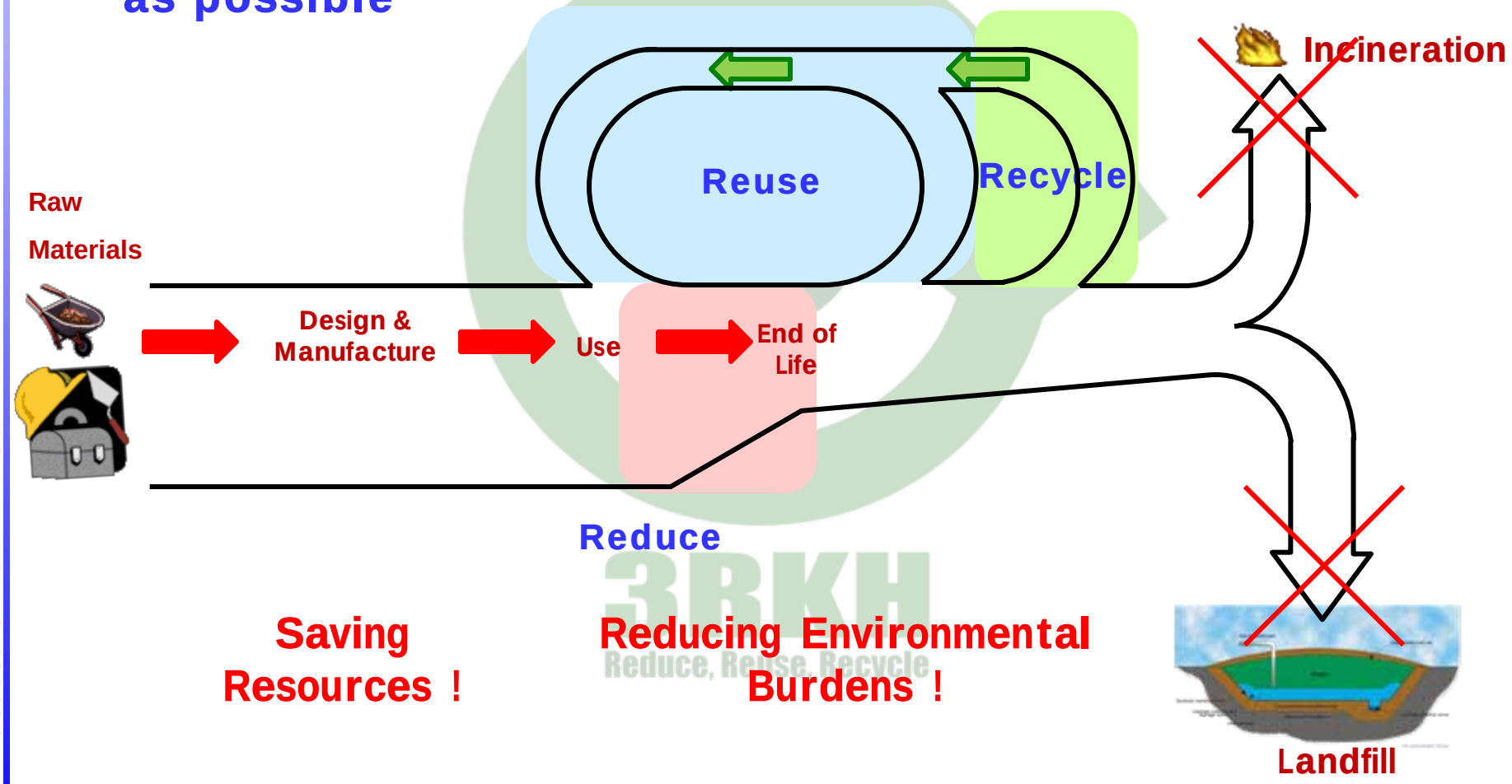
Daily life and Economic Activity



Sound Material-Cycle Society

a society in which

- consumption of natural resources is minimized
- pressure on environment is reduced as much as possible



Prevailing Waste Management

Asia and Pacific region, 20 – 30 % of generated waste is recycled by Informal Sector

Main actors/ contributors to 3R & SWM

INFORMAL SECTOR

- –2R – Reuse & Recycling
- –Scavengers, middle-man, waste dealers, cottage or small-scale recyclers

Major Barriers in developing countries

- ✓Technical feasibility
- ✓Social acceptability
- ✓Economic realities
- ✓Political acceptability
- ✓Geographical conditions

HAND IN HAND – let's clean up this mess!

Sense of Urgency, Env. & Health Impacts

Courtesy: BAN 2006

Chemical stripping operation (computer chips)

In developing countries, Recycling is done by hand in scrap yards, often by children.

Sense of Urgency, Env. & Health Impacts

Informal Sector Recycling

India

- In Delhi, about 2000 tons of garbage per day is sorted by scavengers.
- Cottage and household recyclers (no registration)
- E-waste recycling picking its pace!

Bangladesh

- Recycling of 4- 15 percent of the total generated waste
- E-waste recycling picking its pace!

Pakistan

- Separated at source by housewives 800 tons per day
- Recycled by Informal Sector 1,500 tons/day
- 21,000 waste pickers (young Afghan boys)-Karachi neighborhood

Sense of Urgency, Env. & Health Impacts

Informal Resource Recovery and Recycling: (same everywhere)

INDIA

THAILAND

Sense of Urgency, Env. & Health Impacts

Informal Resource Recovery and Recycling: (same everywhere)

3R Developments in Asia

Developed countries

KOREA

- ✓ Increase the Municipal waste recycling rate from 44% to 50% (2002 – 2008) & decrease 1.3 kg/person-day (1993) to 1.04 kg/person-day (2002) further aiming to reduce to 0.9 kg/person-day till 2008.
- ✓ Target: Year 2011
- ✓ Reduce MSW generation by 12%
- ✓ Waste incinerated/ landfilled by 22%
- ✓ Increase recycling by 53%

TAIWAN

- ✓MSW generated 5.49 Million tons (2005)
- ✓78.7% - Incineration; 20.5% - San. Landfill;
- ✓ 0.7% - Regular Landfill; 0.1% - temp. storage
- ✓New reduction targets for Organic waste:
- ✓ 2007 – 25% : 2011 – 40% : 2020 – 75%
- ✓Reduction in Per-capita waste generation
- ✓1996 – 1.13 kg/person-day
- ✓2005 – 0.67 kg/ person-day

HONG KONG

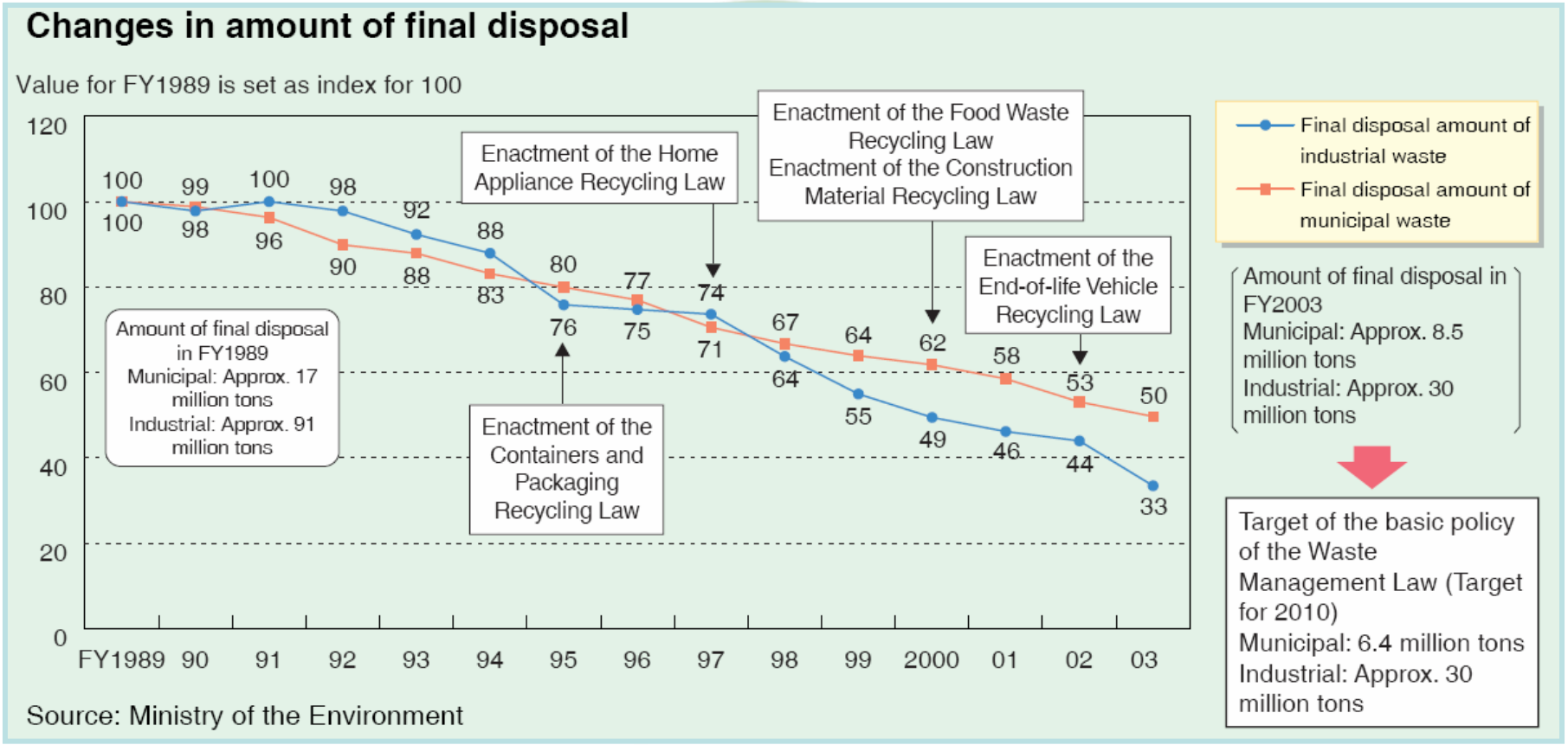
- ✓ MSW generated 6 Million tons (2005)
- ✓43% - Recovered; 57% -Landfilled

SINGAPORE

- ✓10-year blueprint for environmental sustainability launched by the Singapore's Ministry of the Environment and Water Resources in 2002
- ✓Household Recycling: Participation rate by households increased from 22% in 2001 to 54% by end 2004. Singapore Green Plan 2012.
- ✓Recycling rate increased from 44% in 2002 to 48% in 2004 targeted to 60% by 2012.

3R Developments in Asia

Japan

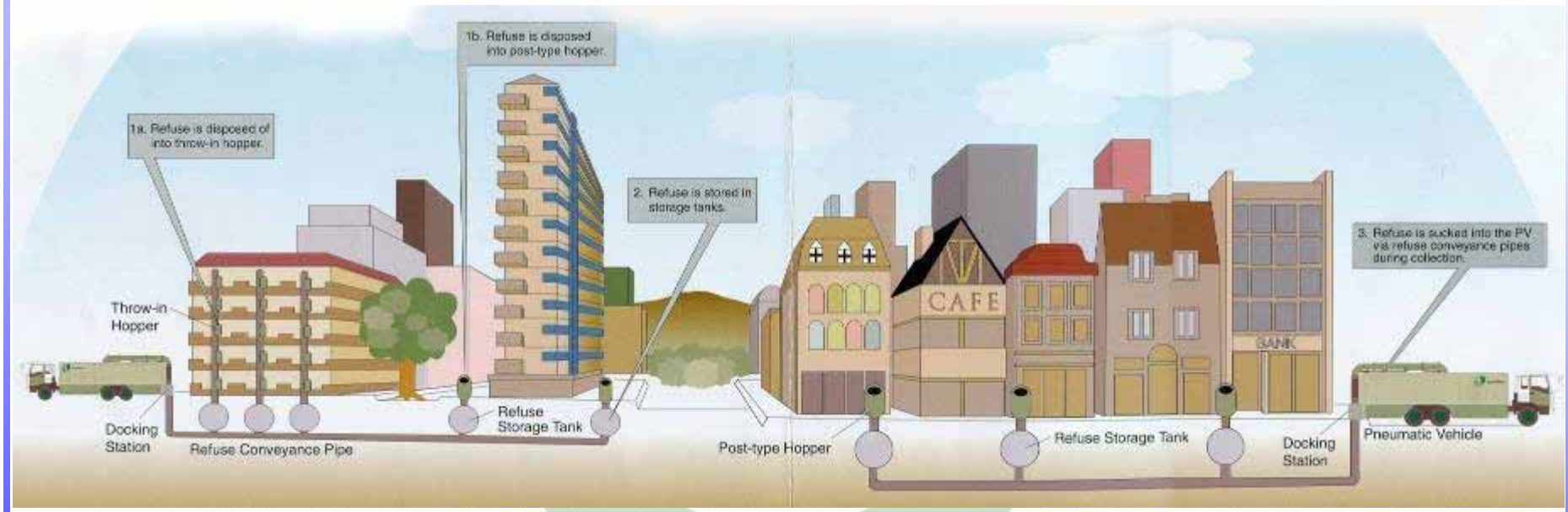


Reduce, Reuse, Recycle

3R Developments in Asia

Singapore

Recyclable Intermediate Chute Storage System (RICH System)



System Brief

- Used in High-rise buildings, offices, multi-storey housings
- Refuse thrown into common/ individual chutes
- Channeled to common storage tank
- Sucked out by a Pneumatic system
- No need for manual transfer of refuse

Courtesy: SembWaste Consultancy & Technology, Singapore

3R Developments in Asia

Singapore

- **Innovative method for storing recyclables within the chute**
- **Helps to reach the recycling target of 60% by 2012**

Courtesy: SembWaste Consultancy & Technology, Singapore

3R Developments in Asia

India

Brighter side

- Private sector participation-(Metro cities)
- Plastic recycling & Composting of organic waste
- Chennai – Exnora (Private Waste Company)
  - Promoting household composting
  - Waste segregation
  - Zero waste approach

3R Developments in Asia

India

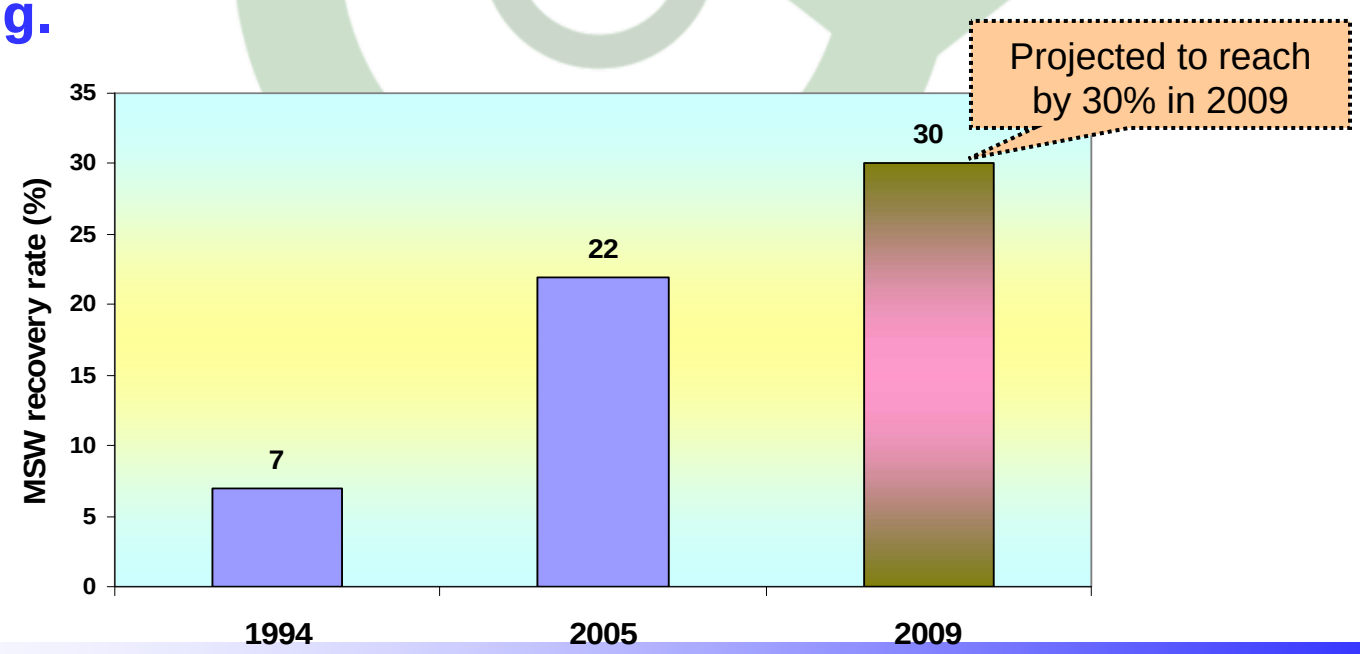
Brighter side

- ✓ Non-biodegradable Garbage (Control) Ordinance, 2006, Maharashtra, India
- ✓ Recycling Schemes
- ✓ Charter on Corporate Responsibility for Environmental Protection
- ✓ Recycled Plastics Manufacture and Usage Rules - amended in 2003
- ✓ Review and Finalization of National Environmental Policy
  - ✹ Adoption of cleaner technology, strengthening of the informal sector system of collection and
  - ✹ Recycling of various materials and develop and implement strategies for recycle,
  - ✹ Reuse and final environmental friendly disposal of plastic waste

3R Developments in Asia

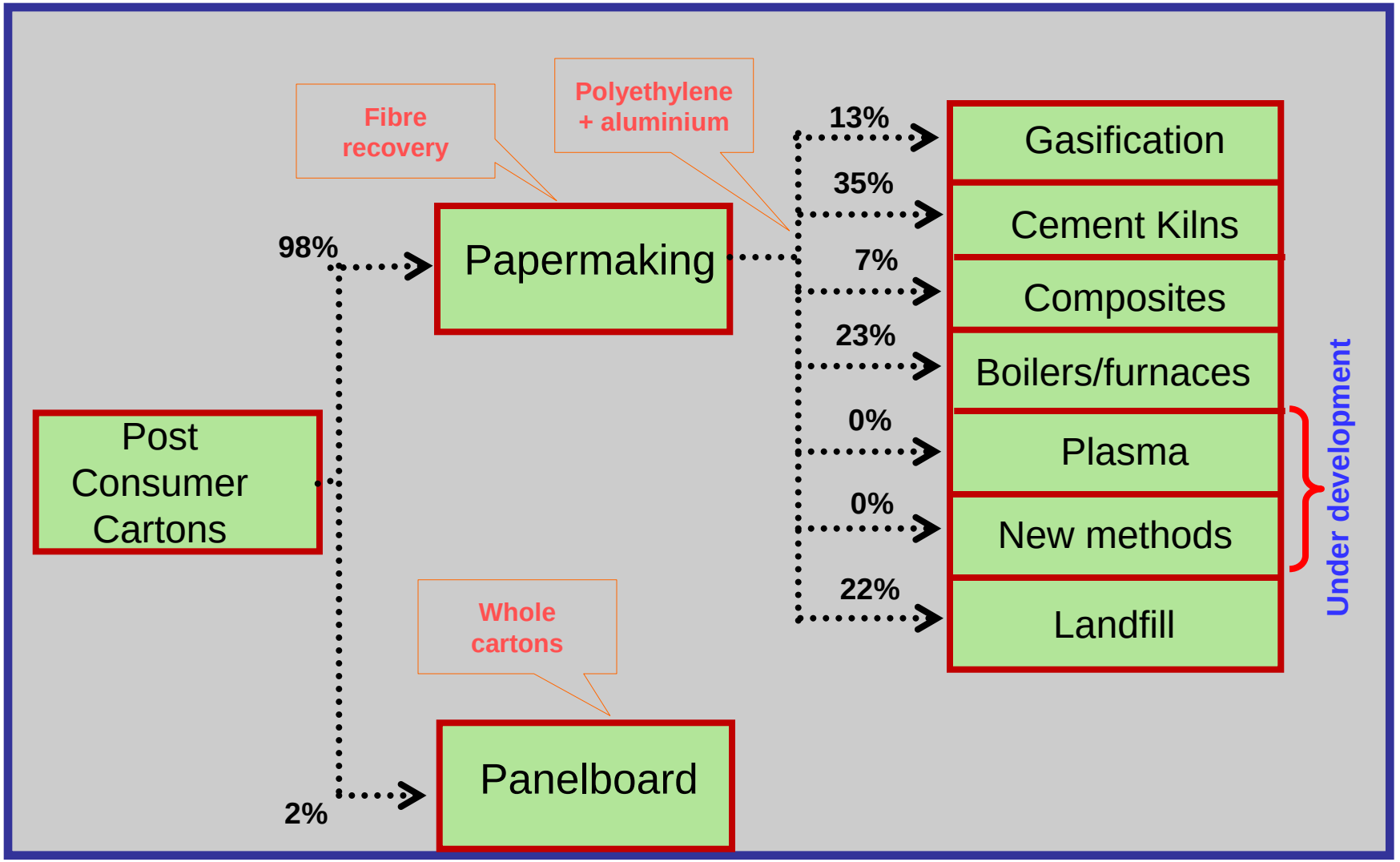
Thailand

- **Waste Recovery: 3R program, introduced in 1994, involves the public in solutions through campaigns, seminars, training and guidelines.**
- **To further promote 3R, Thailand has conducted a pilot project on Waste Exchange Program.**
- **As of 2005, 450 industries are registered on the waste exchange database to explore better waste utilization through recycling.**



3R Developments in Asia

PRIVATE SECTOR INITIATIVES: TETRA PAK



Recycling of Beverage Carton in 2004 Worldwide

Design of Recyclable Products-Tetra Pak Cartons

Volume Reduction: Source Reduction of Solid Wastes

More space is all the better for lesser waste generation!!

3R Developments in Asia

PRIVATE SECTOR INITIATIVES: TETRA PAK

TETRA PAK (THAILAND) – Collection and Sorting

3R Developments in Asia

PRIVATE SECTOR INITIATIVES: TETRA PAK

Baled material
From GGT

Hydrapulper

Pulp recovered
from hydrapulping

Poly – AL residuals

Tetra Pak - Thailand
(Pulping at Fiber Pattana Paper Mill)

3R Developments in Asia

PRIVATE SECTOR INITIATIVES: TETRA PAK

Pulp from Beverage Cartons

Paper Roll for Boxboard Manufacturing

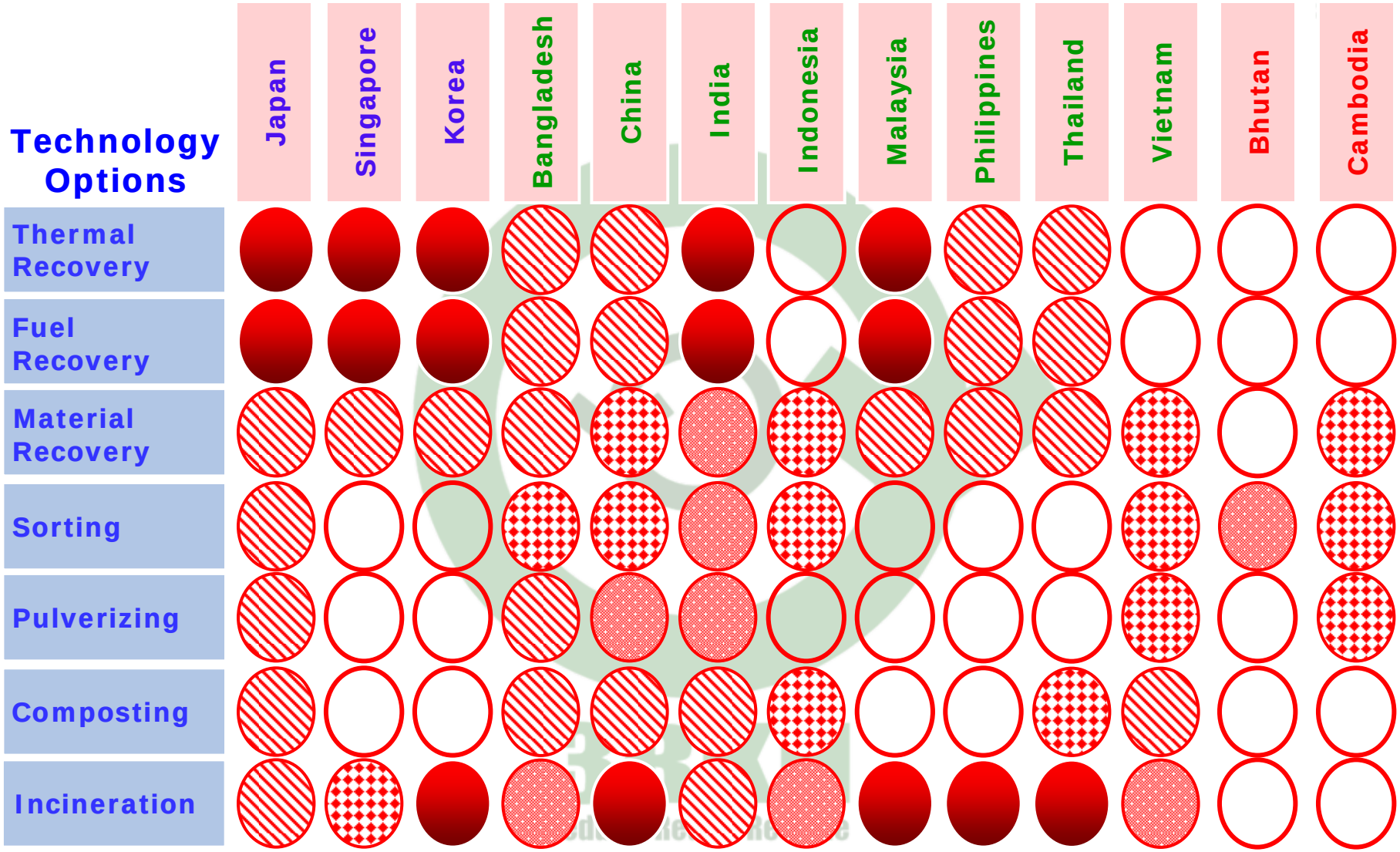
Recycled Products

3R Developments in Asia

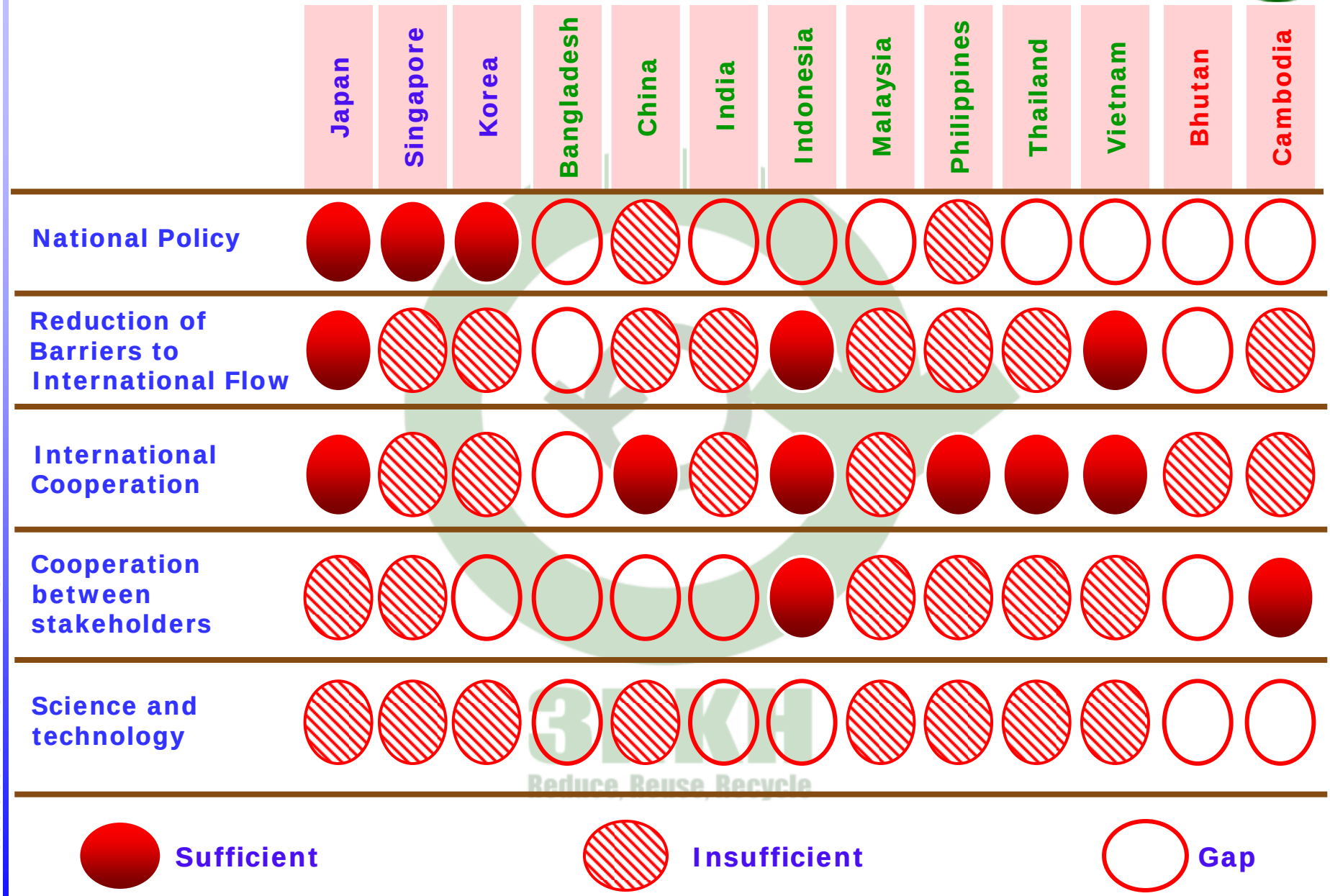
PRIVATE SECTOR INITIATIVES: TETRA PAK

Awareness on Packaging waste
Tetra Pak, Vietnam

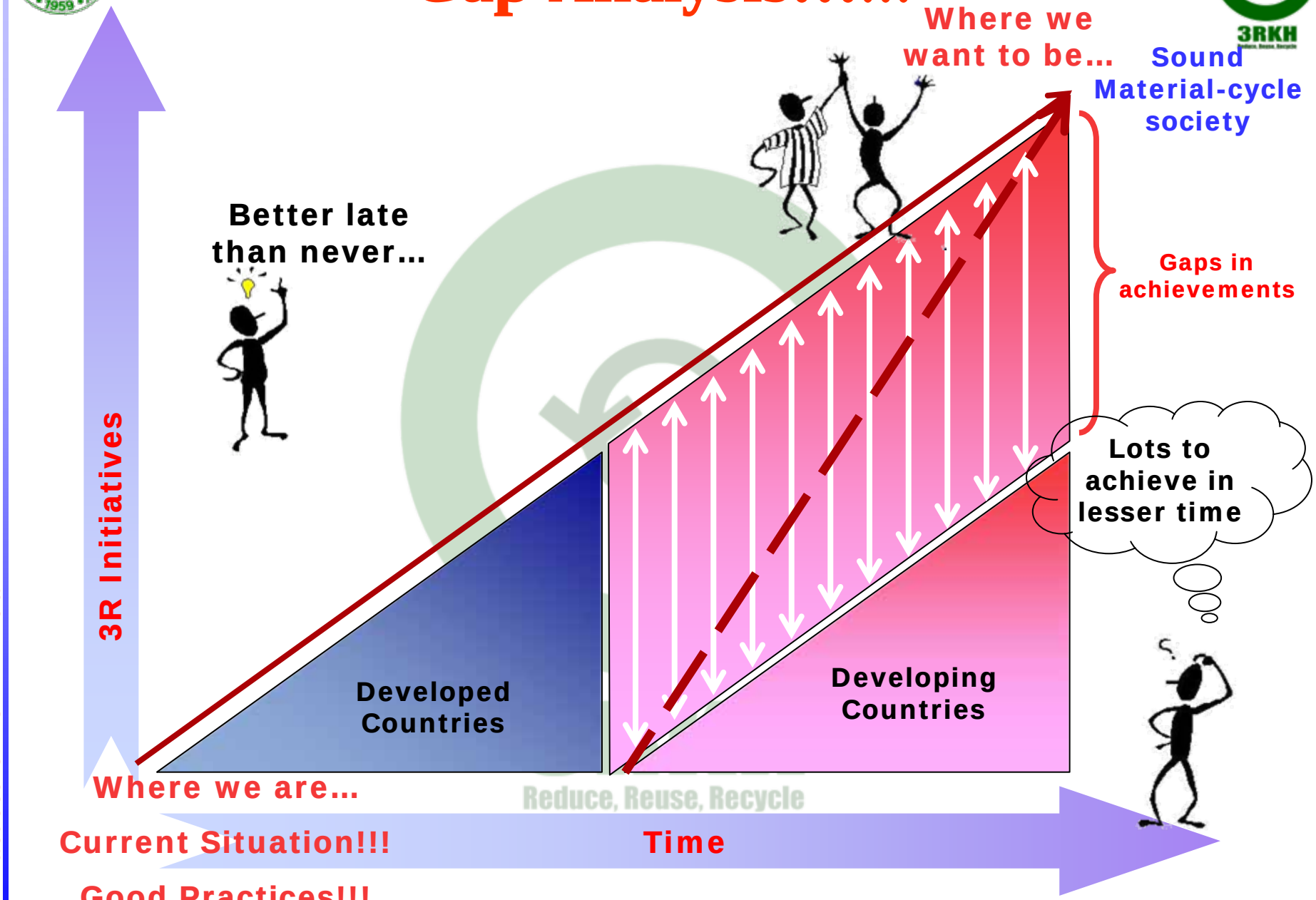
Technology Gaps



Management and Policy Aspects



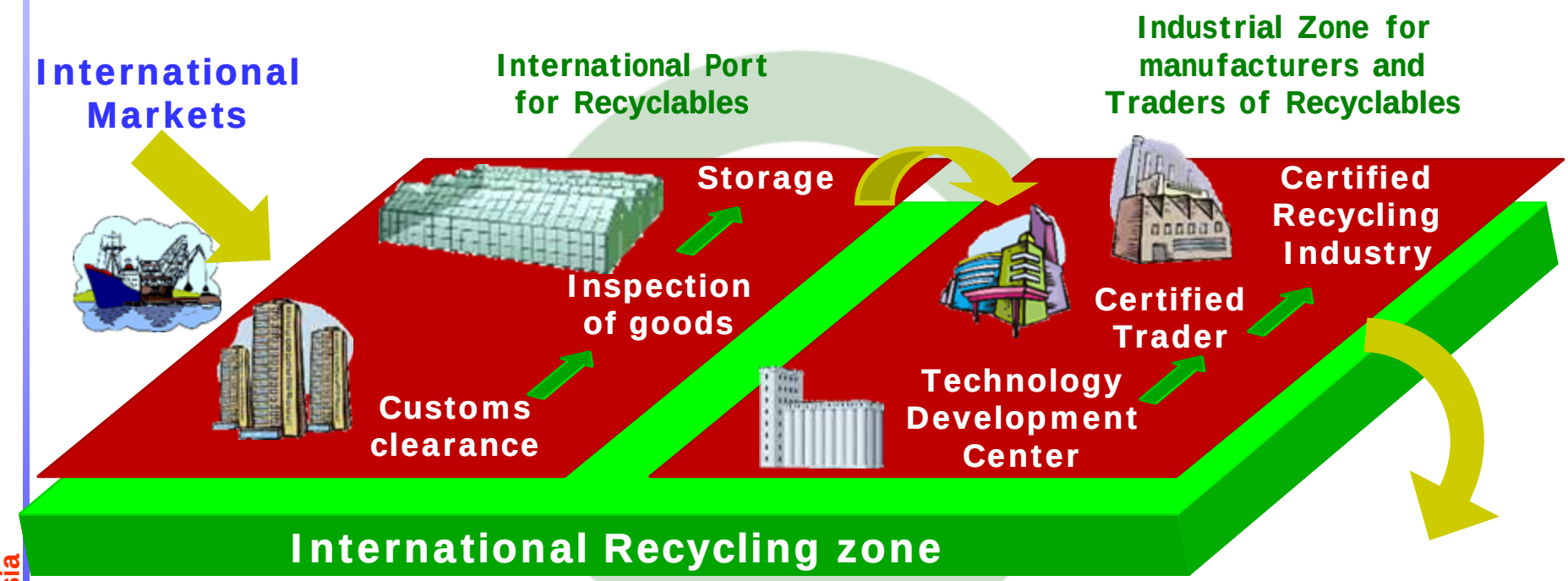
Gap Analysis…!!!



Future Prospects of 3R Activities

- Eco-Industrial Networking
- Promoting Green Procurement
- Promoting Efficient and Clean Energy
- Awareness activities - Knowledge Management
- Promoting Circular Economy (CE)
- Creating Regional Recycling Centers

International Recycling Zones



- Bonded Zone
- Soft Loans
- Facility Investment Tax Reduction

Domestic Markets

Source : IGES, 2005

Conclusions

- Recycling is predominantly in the informal sector & uses primitive technology
- Very little instances of promoting formal, 3R-based solutions for waste crisis
- Specific policies emphasizing the need for 3R – very rare in Asian countries – exceptions do exist
- Technology Transfer and Policy Reformulation are essential to promote 3Rs
- Cooperative efforts – between and within countries are the need of the hour to promote a 3R-based economy.

First of 3R - Reduce

Success depends more on human behavior

Technology, policy and other measures take second place

Reuse and Recycle

Needs a driving force to realize the benefits

Motivation, Technology and Policy

Thank you all

Reduce, Reuse, Recycle

Lets act soon for 3Rs