

Application of the Lifecycle Approach for designing an integrated system for sustainable waste management

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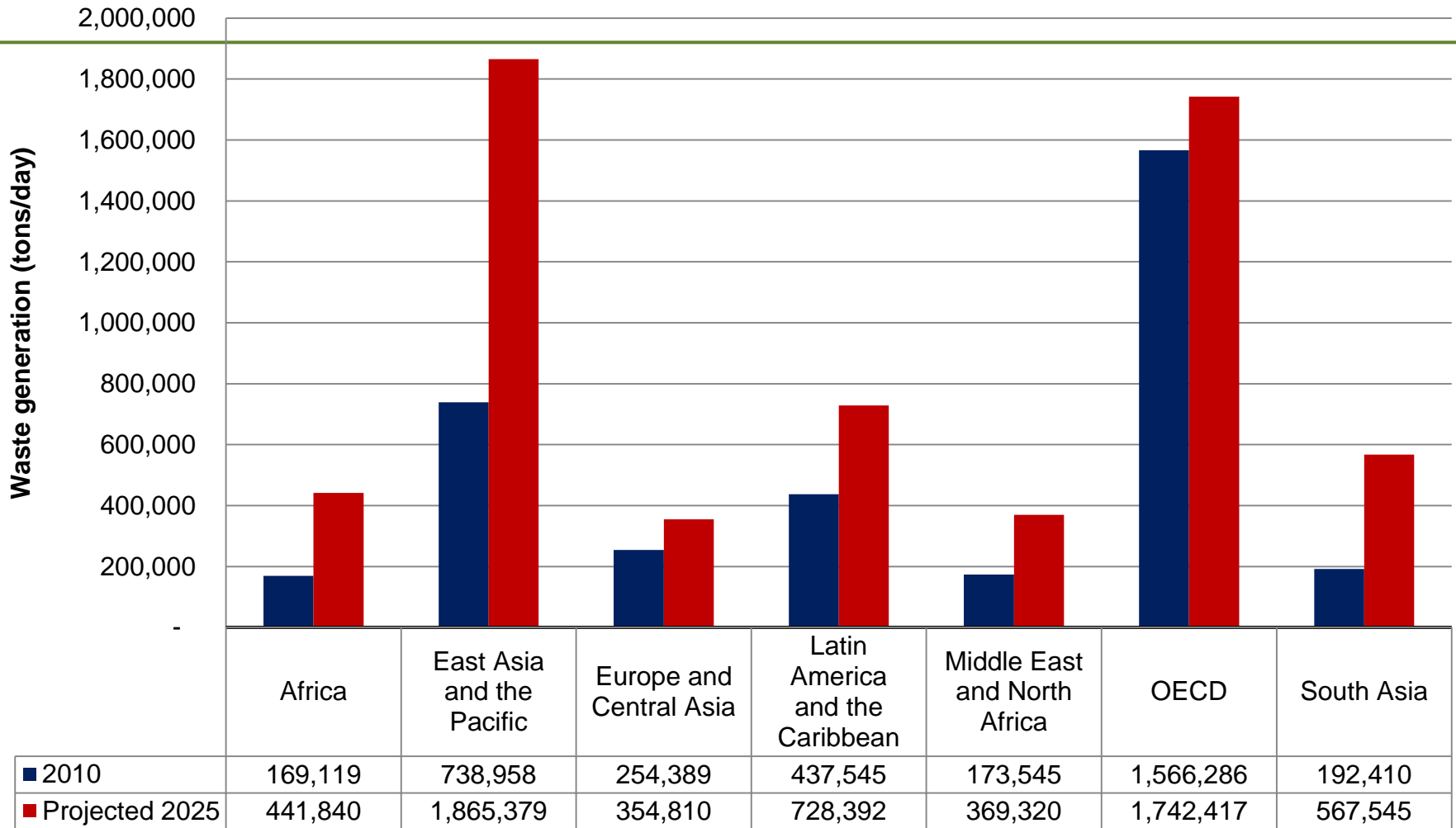
- IGES is a Japanese policy research institute promoting sustainable development in the Asia-Pacific region
- Have offices in Hayama, Tokyo, Kobe, Kitakyushu, Beijing and Bangkok
- The institute's research focuses mainly on environment related policies in developing countries
- IGES employs around 90 researchers
- Two groups are working closely with solid waste management:
 - Sustainable Consumption and Production (SCP)
 - Kitakyushu Urban Center (KUC)



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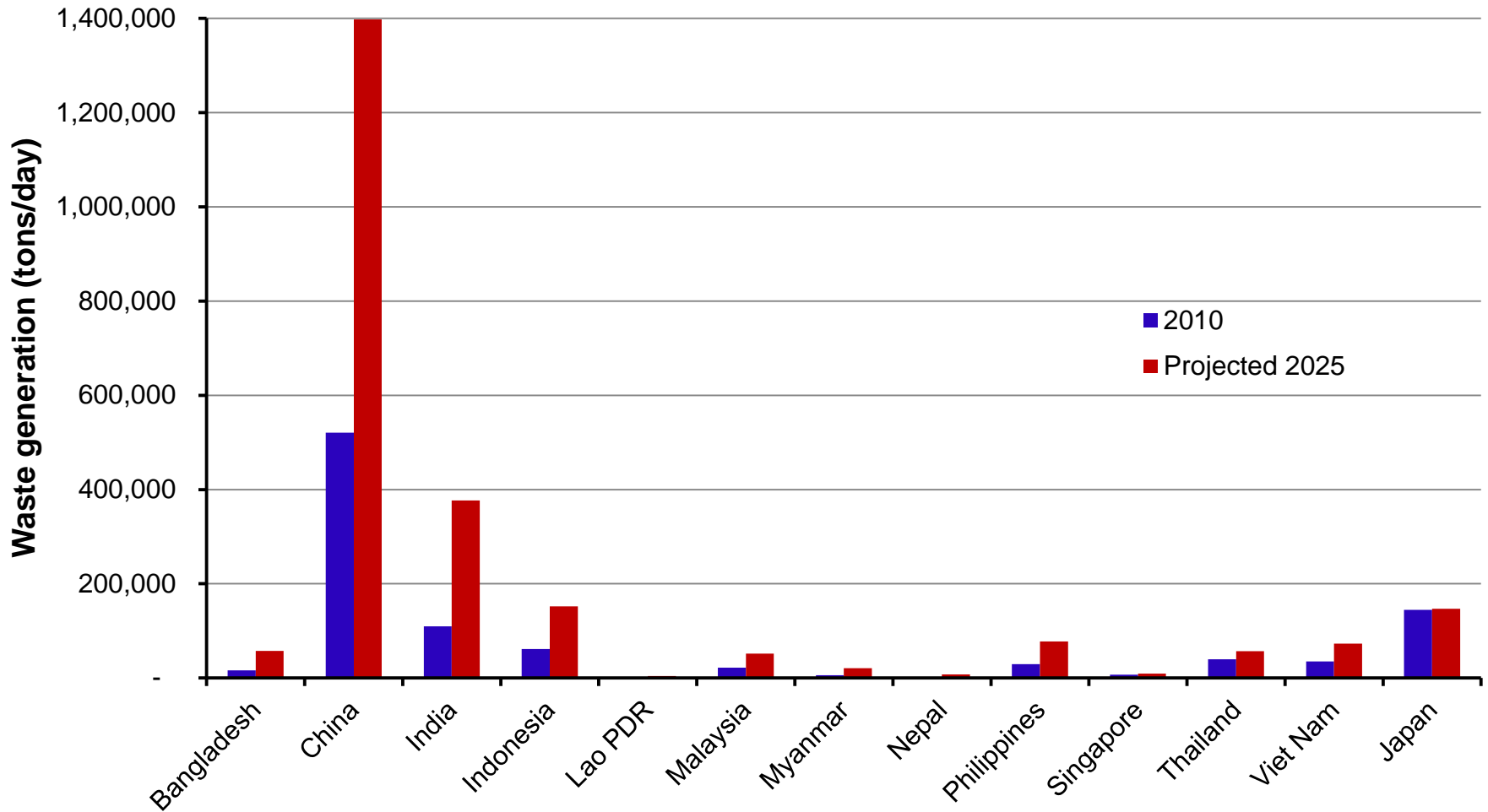
- Waste generation and conventional waste management practice
- Integrated approach and lifecycle approach (LCA) for sustainable waste management
- The 3Rs (reduce, reuse, recycle) as a sustainable waste management that associated with LCA and integrated approach
- Examples of 3Rs policy at national and implementation at local level in developed and developing countries

By 2025, waste generation will be doubling in some regions



Source: Original data from Hoornweg and Bhada-Tata, 2012

Waste generation by country in some Asian countries



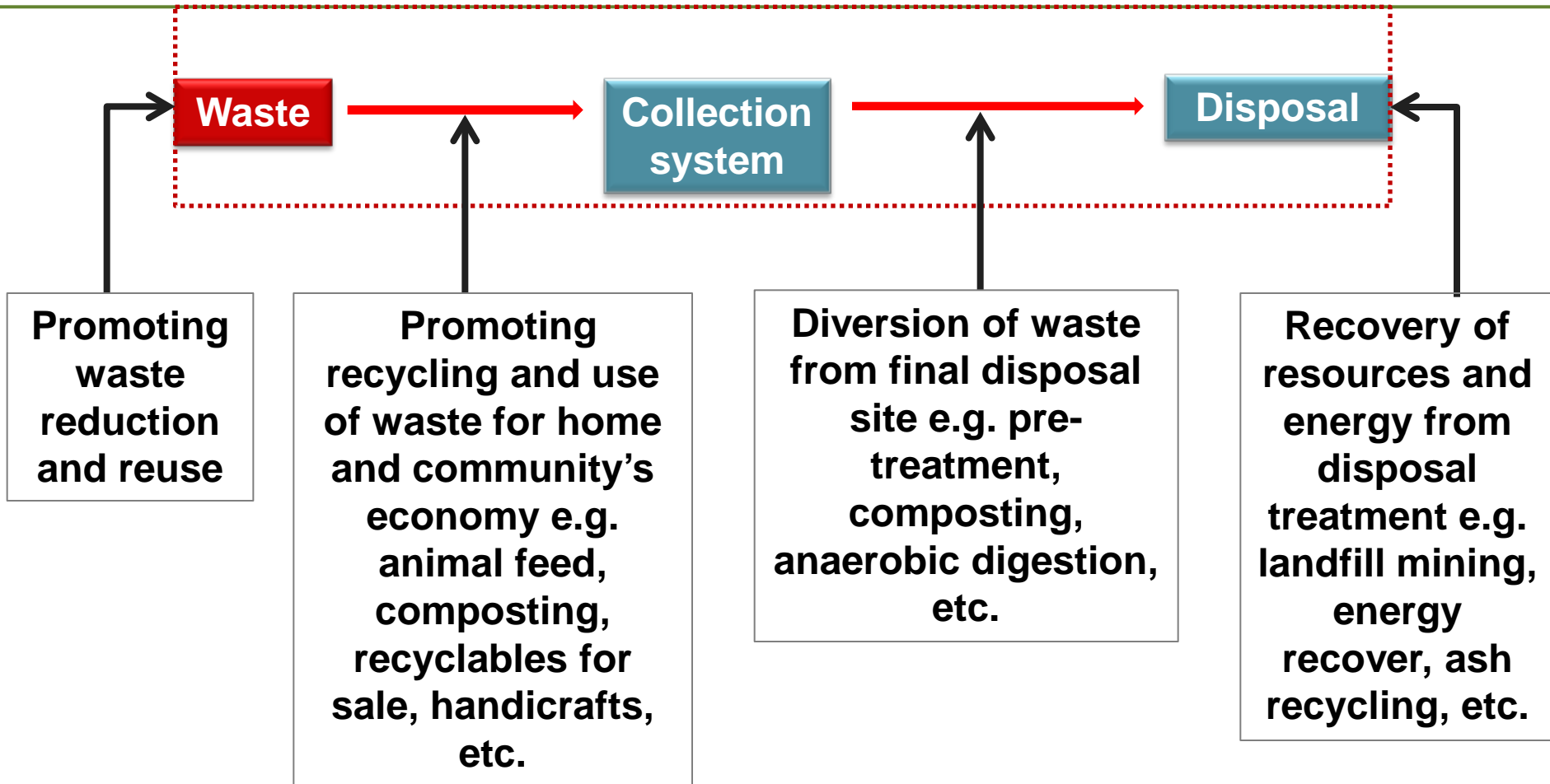
Source: Original data from Hoornweg and Bhada-Tata, 2012

Is the conventional waste management practice sustainable?

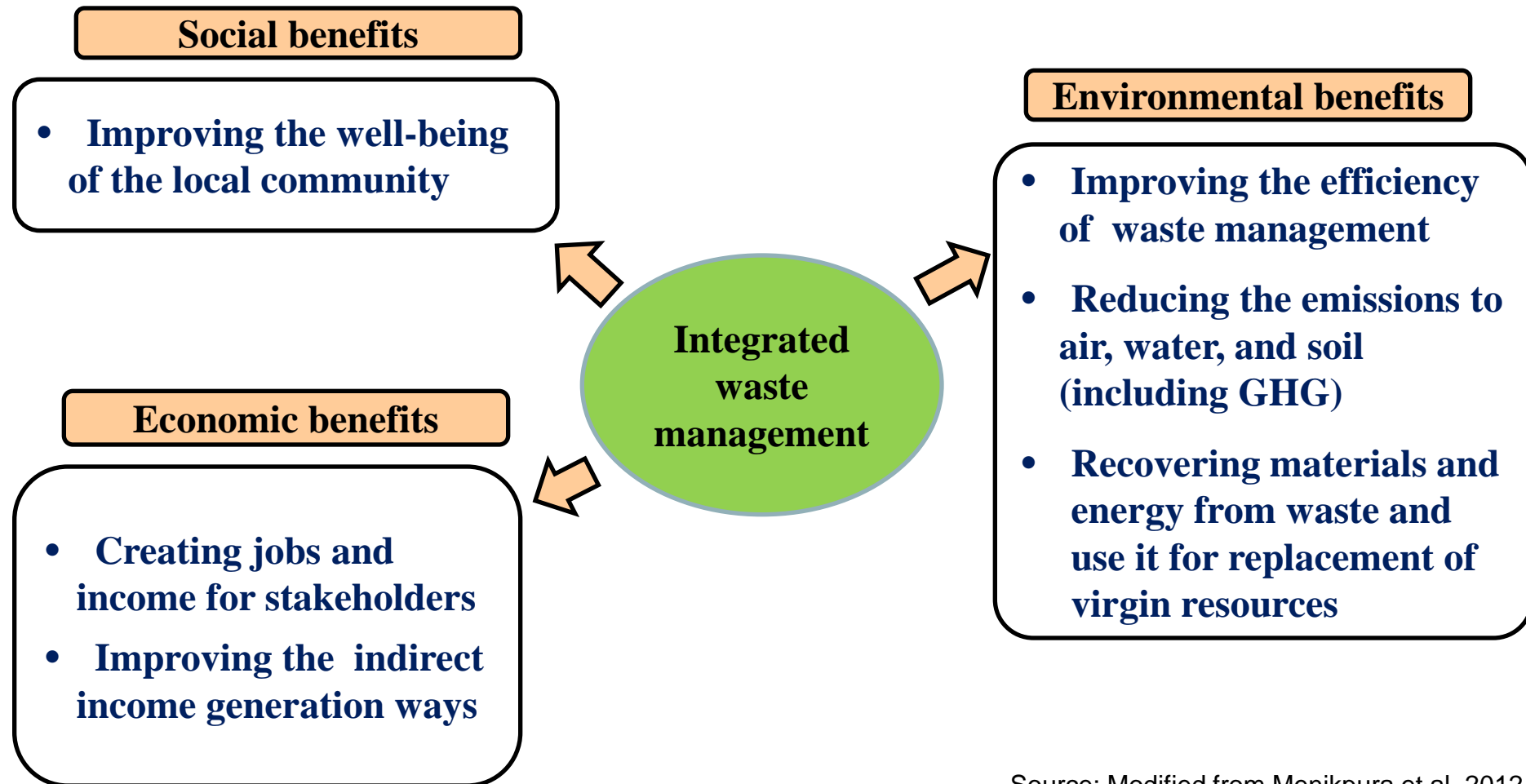
- The conventional practice of ‘collection and disposal’ is unsustainable in term of resource inefficiency, environmental impacts and to some extent socio-economic impacts
- Collection coverage is low in developing countries because of budget constraint
 - How the city can increase coverage of collection for waste that being increased every year?
- Open dumping and sometimes burning are common practiced in developing countries
 - How the city will look like if more waste is dumped and burnt?
 - How is the health conditions of the local residents?

- Upgrading open dumping to sanitary landfill (sometimes equipped with landfill gas capture and/or flaring system) is being promoted in many countries
 - How city can find enough land to dispose all of the waste that being increased every year?
 - Why we bury many resources to the landfill?
- Some countries, using incineration to solve the problem of land scarcity, sometimes energy is recovered.
 - How much the city spent for the construction and operation?
 - How is the air pollution?
 - What is the actual life time of the incineration plant?
 - Why we burn all resources despite some fractions can be reused and recycled?

How an integrated approach can improve the SWM in a sustainable manner?



Contribution of integrated waste management to solve waste management crisis

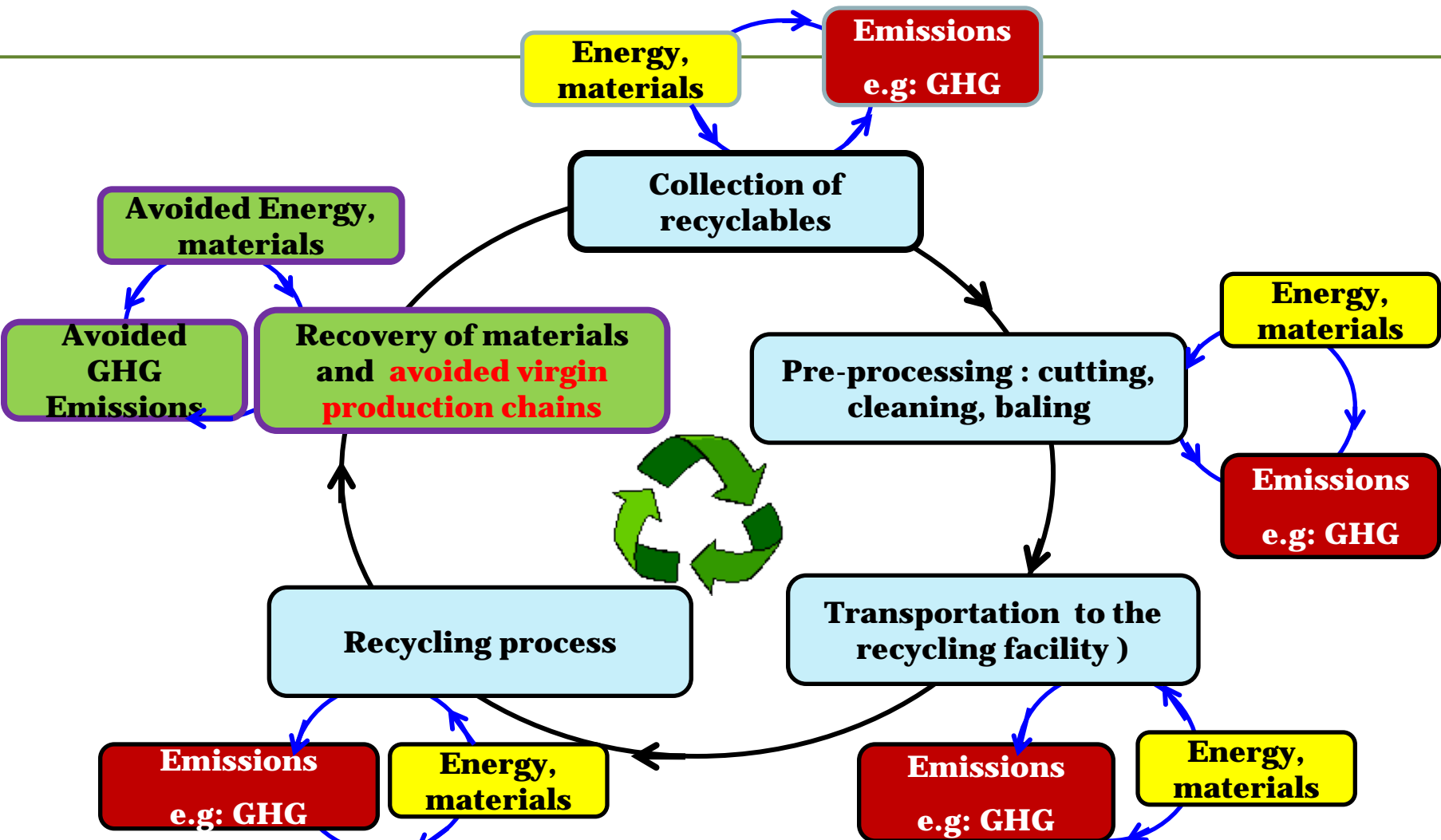


Source: Modified from Menikpura et al, 2012

Why is the lifecycle approach a concern?

- Every technology has pros and cons
- Therefore, we need to consider both direct and indirect impacts of each technologies prior to the decision making
- There are two types of LCA analysis
 - Cradle to grave → from resource extraction to production to disposal
 - Cradle to cradle → from resource extraction to production to **reusing and recycling (including organic waste utilization)**

Cradle-to-cradle analysis framework of recycling

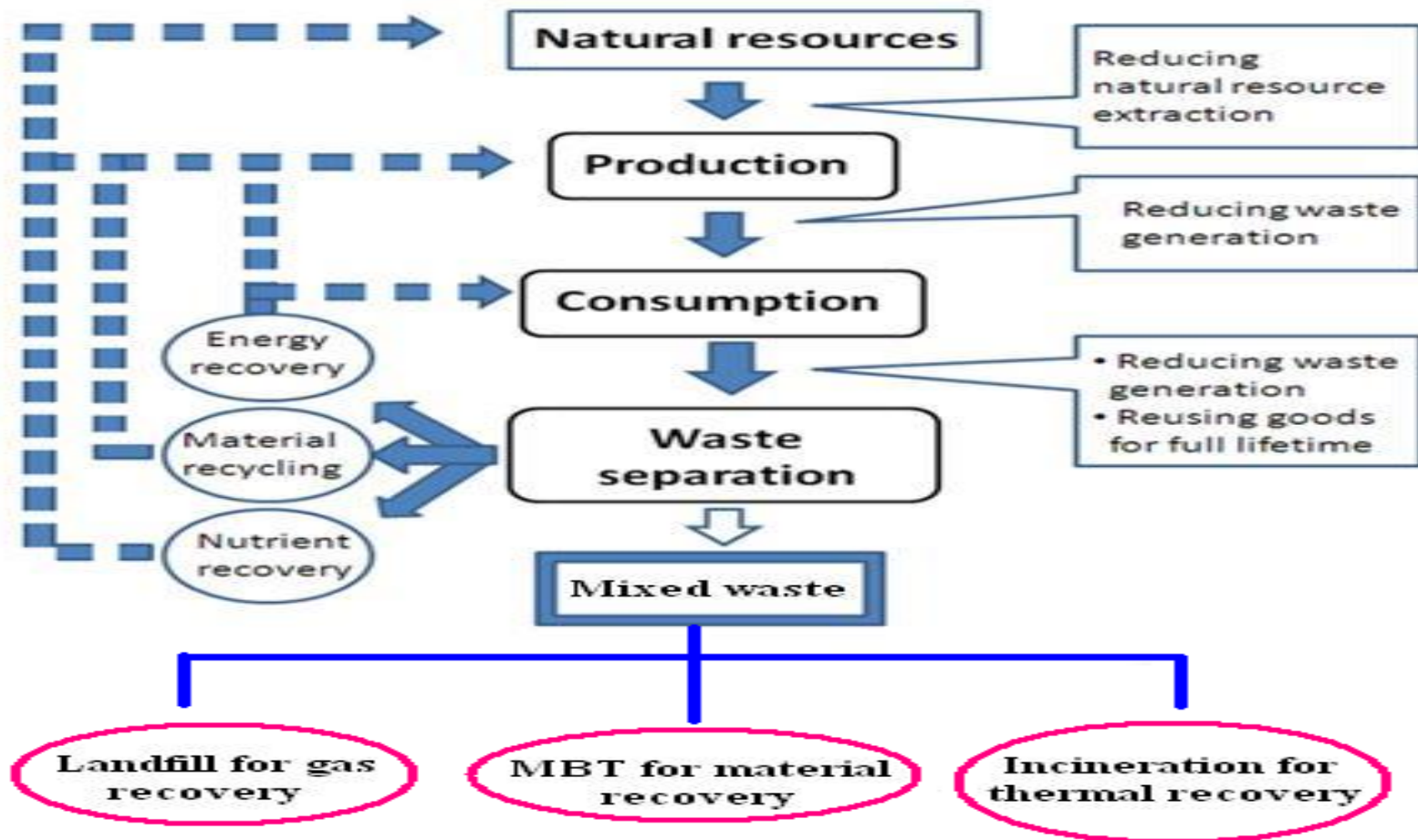


Source: Menikpura et al, 2012

The 3Rs (reduce, reuse, recycle) as a sustainable waste management approach

- (i) Reducing waste generation at the production and consumption stages,
- (ii) Encouraging the reuse of materials and products until they can no longer function properly, and
- (iii) Promoting the recycling of materials for further use and recovering valuable resources such as materials, nutrients and energy prior to final disposal

Framework of the 3Rs for sustainable waste management



Source: Sang-Arun et al, 2011

The 3R approach at the national level

Japan

- Officially, introduced the 3Rs for waste management in 2000 → **Sound material cycle society**
- Internationally promoted since 2005.

Indicator	2000	2011
Waste generation rate (kg/person/day)	1.19	0.98 ↓
Recycling rate (%)	15.9	20.4 ↑
Remaining lifetime of landfill (yr)	12.8	19.4 ↑
Cost reduction (%)	-0%	-25% ↓

3Rs related Law/Plan in Asian countries

Country	3R context
Bangladesh	National 3R Strategy for Waste Management, 2011
Cambodia	National Strategic Plan on Integrated Solid Waste Management (draft)
China	Circular Economy Promotion Law
India	National Environmental Policy, 2006
Indonesia	Waste Management Law, 2008
Philippines	Ecological Solid Waste Management Act, 2000
Thailand	Eleventh National Economic and Social Development Plan, 2012 National 3R Strategy (draft), Law for the Promotion of Waste Reduction, Reuse and Recycling (draft)
Viet Nam	Law on Environmental Protection, 2005

The 3Rs at local level: Yokohama, Japan



Area 437.4 km²

Population 3.7 million

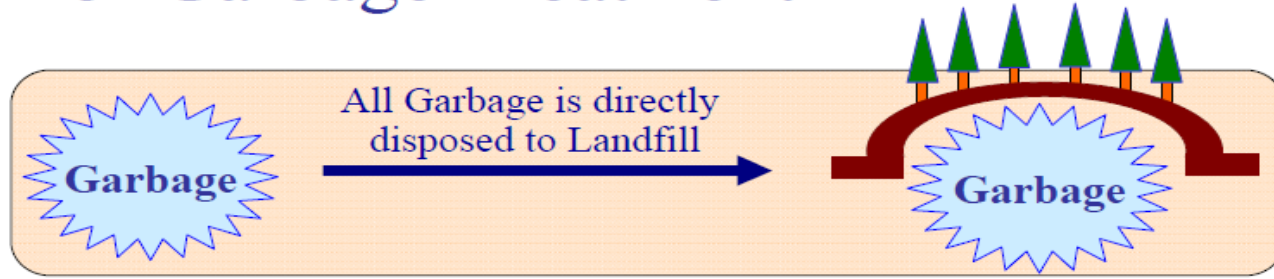
Population density 8,459 person/km²

Roadmap of municipal solid waste management of Yokohama City

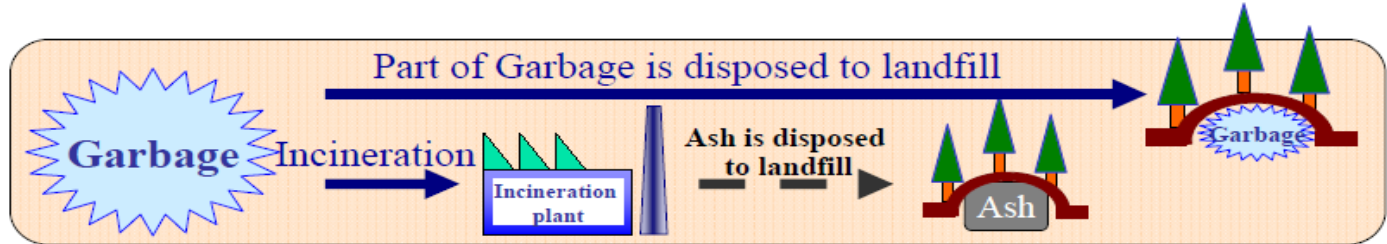
Year	Waste management practice and plan
Until 1949	Landfill + Sanitary landfill
1950	Sanitary landfill + Incineration
1970	Incineration + Sanitary landfill + 3Rs
2003	3Rs - G30 Plan + Incineration + Sanitary landfill
2011	3R Dream Plan (2010-2025) + Incineration + Sanitary landfill

Transition of Garbage Treatment

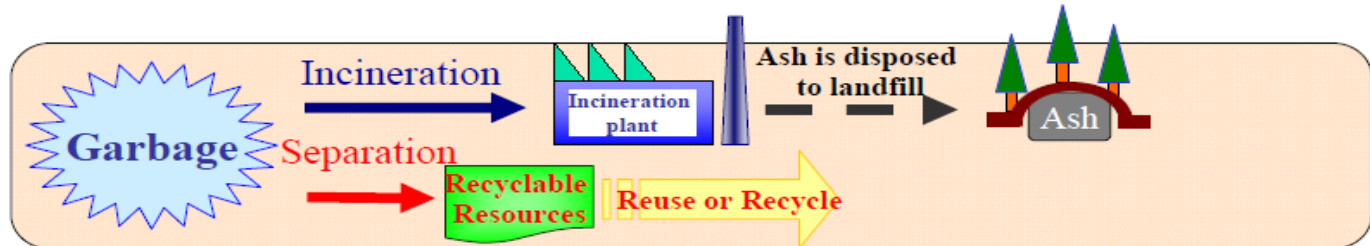
~1940's
 [1930
 Population 620 k
 Total weight of waste 80 k-t]



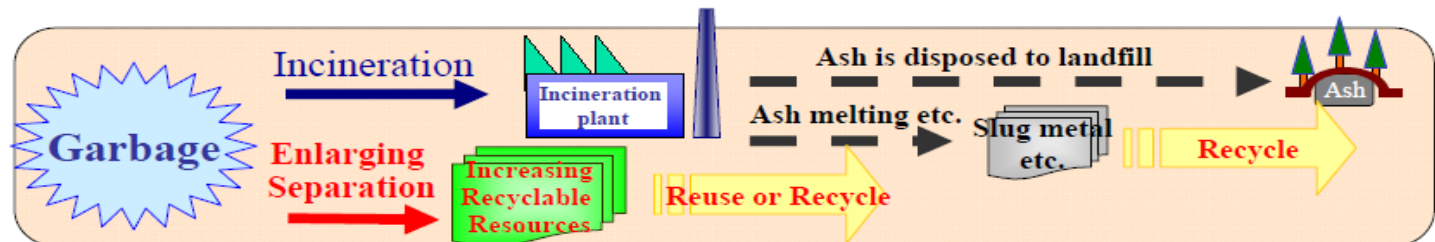
1950's~1960's
 [1955
 Population 1.14 mil
 Total weight of waste 90 k-t]



1970's~1990's
 [1986
 Population 3.05 mil
 Total weight of waste 1.19 M-t]



2000's~
 [2008
 Population 3.66 mil
 Total weight of waste 0.95 M-t]



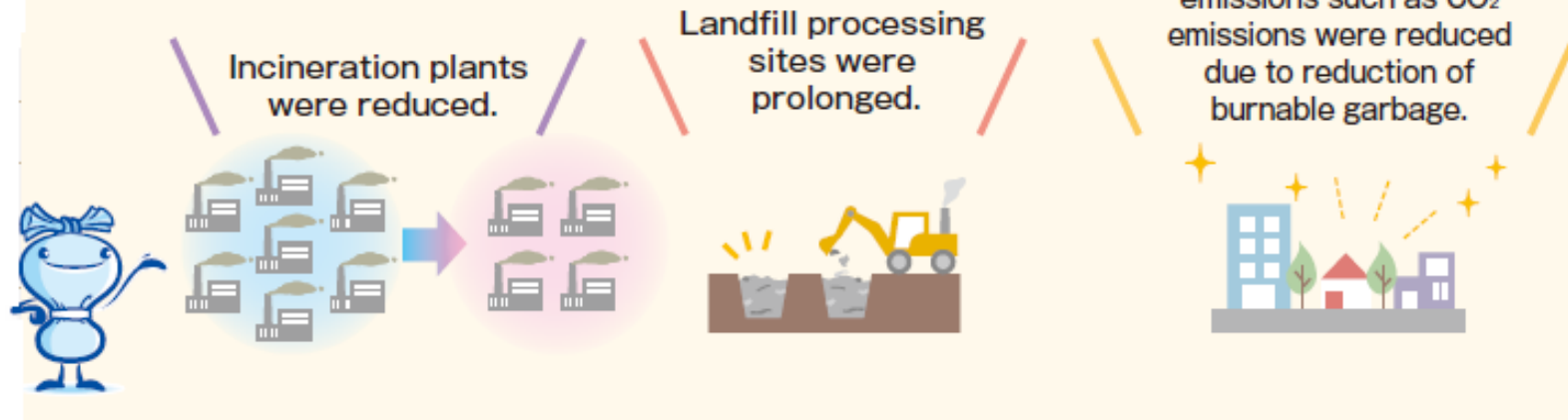
Resources & Wastes Recycling Bureau, City of Yokohama

Graphic by Yokohama City, 2011

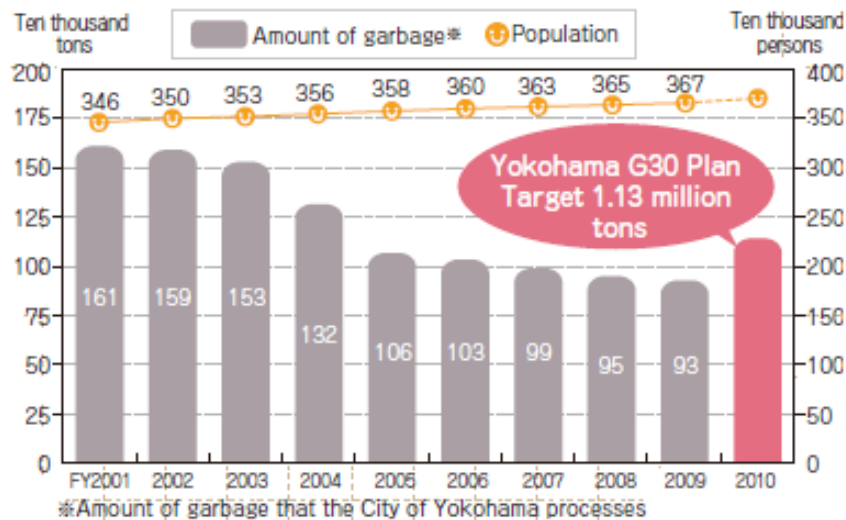
Yokohama G30 Plan

- By 2010, the G30 Plan aims to reduce waste by 30% of the amount of garbage that Yokohama City **treated** in 2001.
- Activities included awareness raising, campaign and information dissemination to residents, increase items for separation from 7 to 15, increase inspection of delivered garbage, engage in school education, welcome site visit, etc.
- According to report of Yokohama city, the city achieved its 30% reduction target in 2005 and 42% reduction in 2010. The city can save 1.1 billion JPY (110 million USD) from avoiding reconstruction of incineration and decrease 600 million JPY (6 million USD) of net annual budget for waste management.

As a result

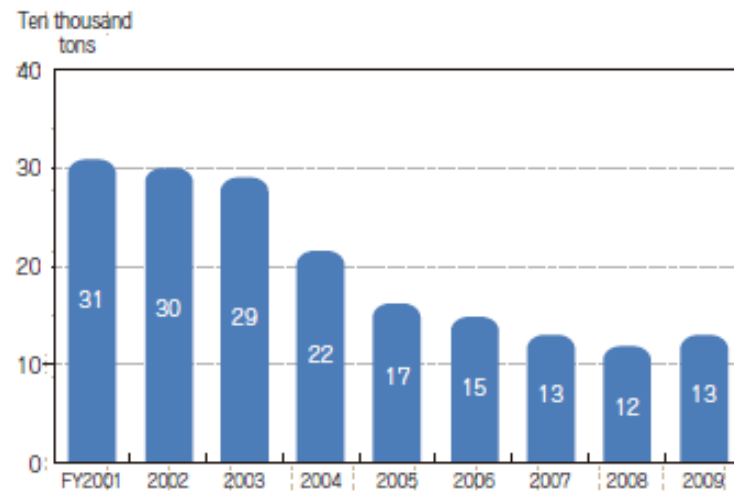


[Change of the amount of garbage and population]



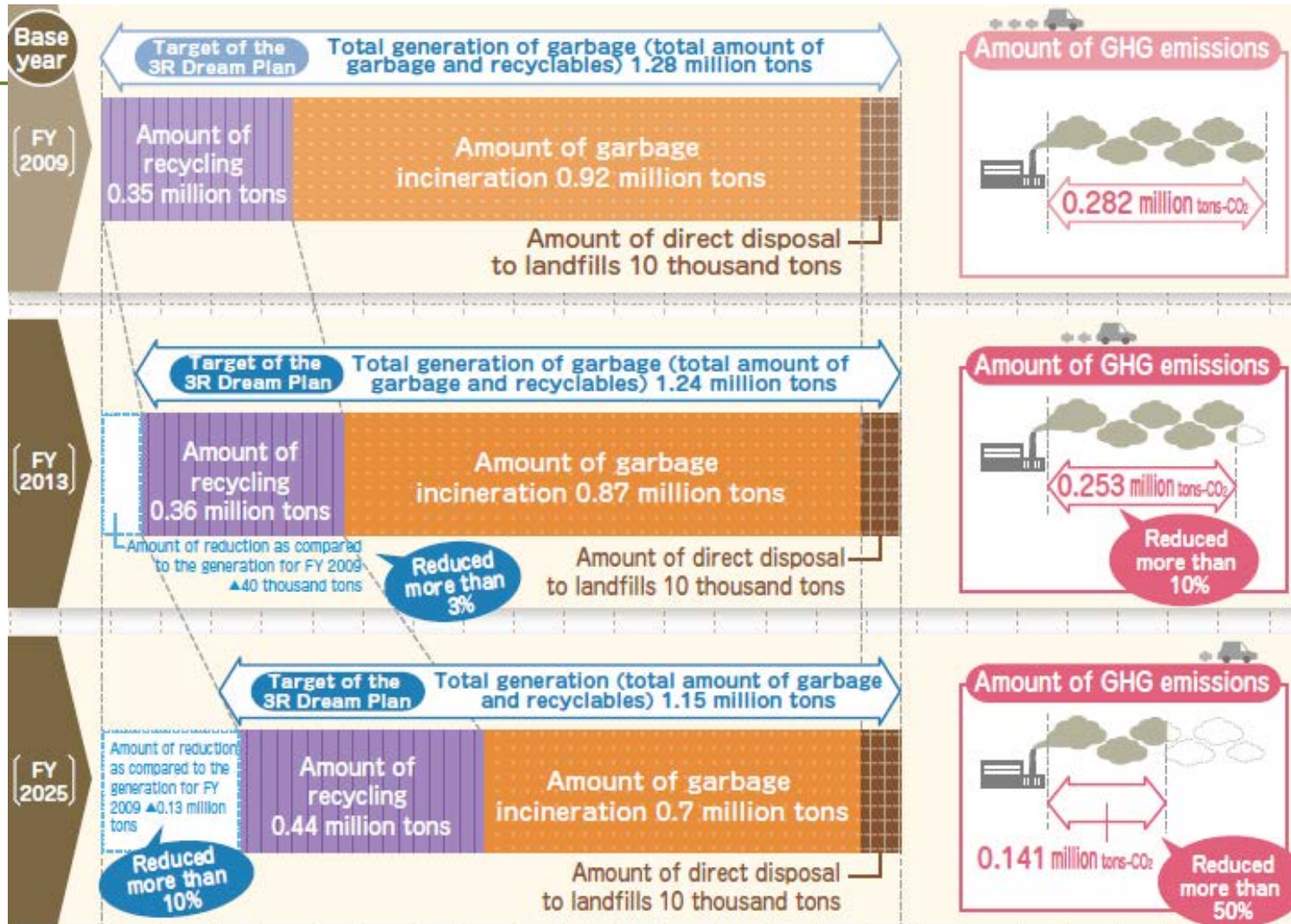
Excluding recyclables

[Change of the amount of general waste to landfills]



Graphic by Yokohama City, 2011

3R Dream Plan (2010-2025)



Graphic by Yokohama City, 2011

The 3Rs at local level: Phitsanulok, Thailand



Area 18.3 km²

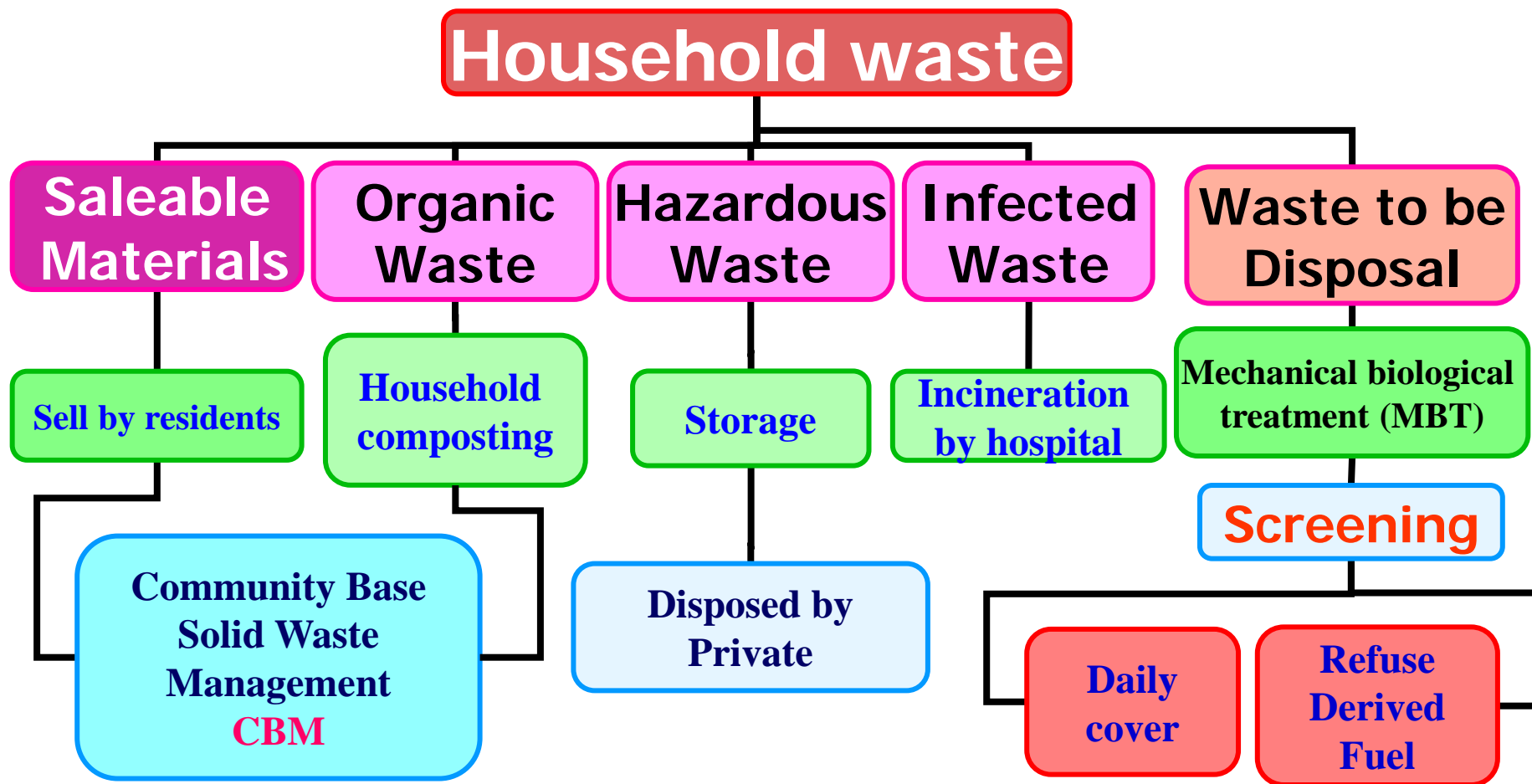
Population 90,000

Population density 4,918 person/km²

Roadmap of municipal solid waste management of Phitsanulok Municipality

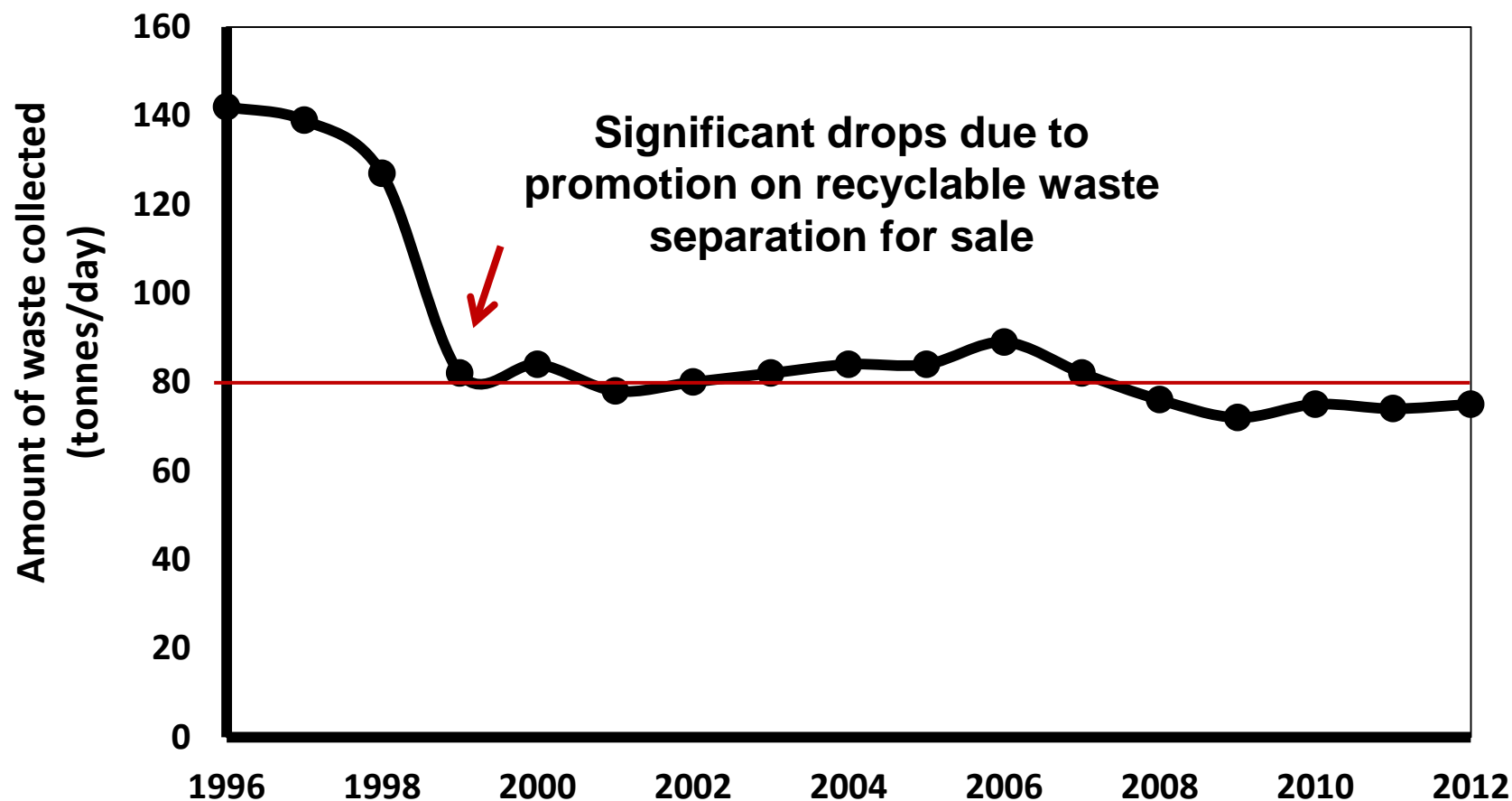
Year	Waste management practice and plan
Until 1995	Open dumping and burning
1999	Sanitary landfill + Recycling
2000	Sanitary landfill + Recycling + Composting
2002	Sanitary landfill + Recycling + Composting + Other 3Rs
2003	Sanitary landfill + Recycling + Composting + Other 3Rs + Community based waste management (CBM)
2005	Mechanical biological treatment (MBT) + Recycling + Composting + Other 3Rs + CBM + Sanitary landfill
2010	MBT + Recycling + Composting + Other 3Rs + CBM + RDF + Sanitary landfill and aims for zero waste landfill

Integrated waste management model of Phitsanulok Municipality



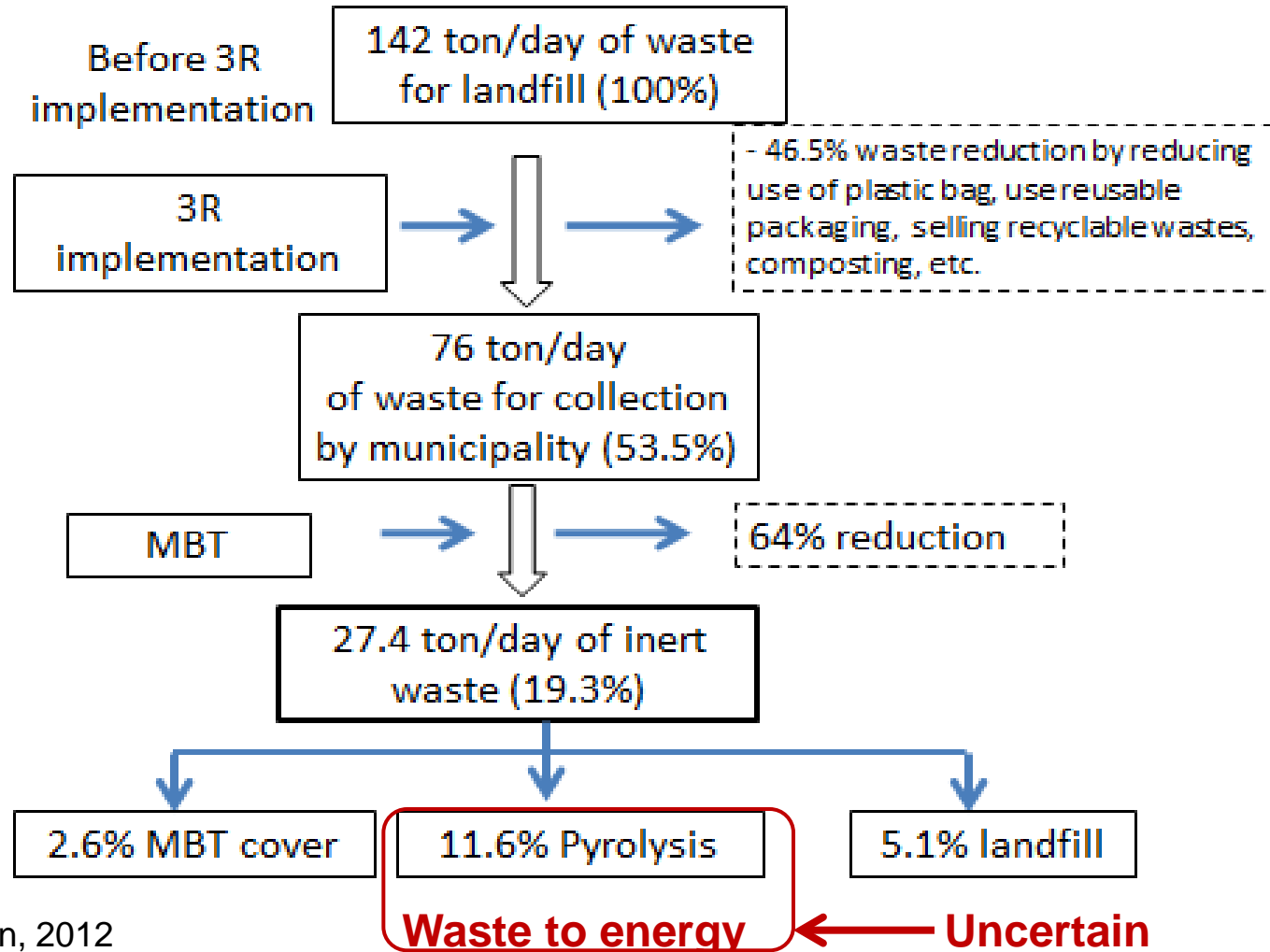
Source: Phitsanulok Municipality

Change in waste amount to collection and treatment of the municipality



Source: Original data from Phitsanulok Municipality

Achievements



Source: Sang-Arun, 2012

Recommendations

- The conventional waste treatment of ‘collection and disposal’ is not a sustainable waste management approach especially under the rapid increasing of waste generation in developing countries.
- As each technology has pros and cons, a life cycle approach should be used for selection of waste treatment technologies.
- One technology is not best suit to all types of waste, therefore a combination of technologies for integrated waste management is recommended.
- The 3Rs is a sustainable waste management strategy that associated with lifecycle and integrated approaches and it can be tailored made to suit the local conditions of both developed and developing countries.

Thank you very much for your attention



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