

3R principles as an approach to designing NAMAs on the municipal solid waste sector: opportunities and challenges

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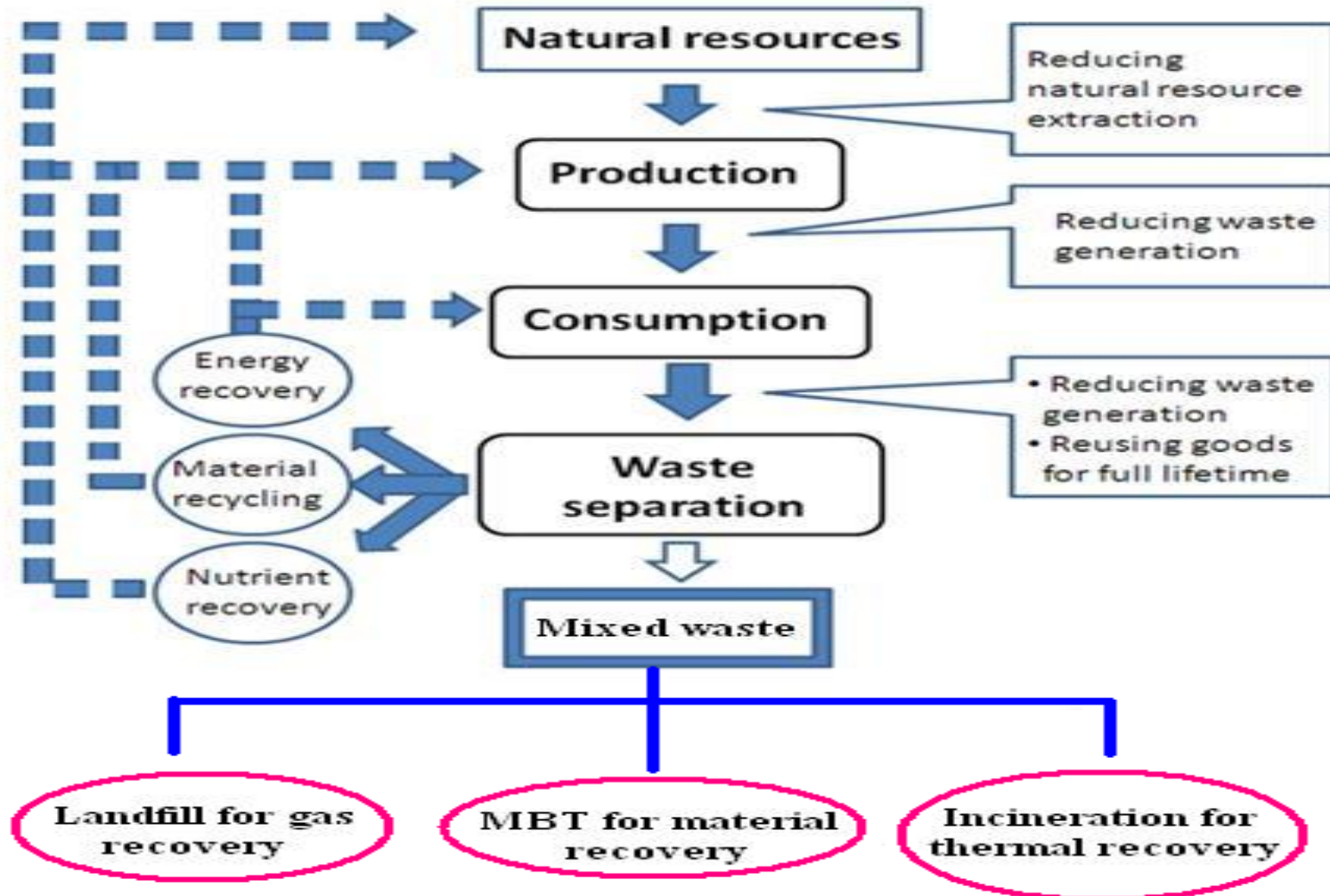
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GHG emissions from solid waste management

According to IPCC guidelines, GHG emissions related to solid waste management can be categorised into different groups

Source of GHG emission	Categorised under waste sector	Categorised under non-waste sector
<ul style="list-style-type: none"> • CH₄ emission from landfills/open dumping, composting of organic waste • CH₄ emission from incineration and open burning (minor) 	★	
<ul style="list-style-type: none"> • CO₂ emission from incineration without energy recovery and open burning • CO₂ emission from incineration with energy recovery 	★	★
<ul style="list-style-type: none"> • N₂O emission from combustion and composting 	★	
<ul style="list-style-type: none"> • GHG emission from utilisation of fossil fuel for waste transportation, operational activities and grid electricity consumption for operational activities and recycling 		★
<ul style="list-style-type: none"> • GHG emission from manure and farm waste management 		★

The 3Rs for sustainable waste management, climate change mitigation and enhance resource efficiency



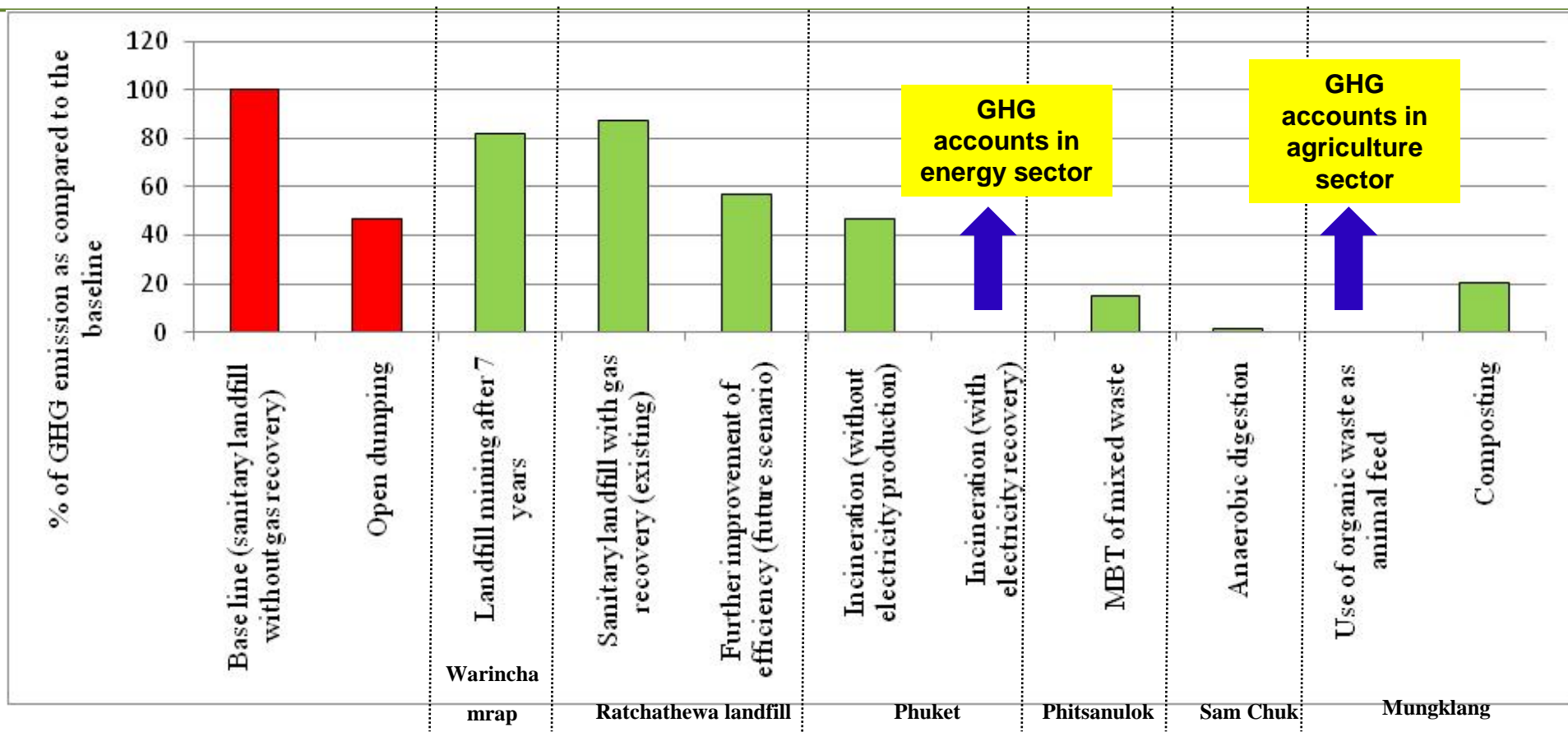
Climate co-benefits of 3Rs in various sectors

Sectors	Climate co-benefits
Waste	<ul style="list-style-type: none"> - Reduced methane emissions from landfill - Reduced carbon dioxide emissions from burning of plastics
Energy and transport	<ul style="list-style-type: none"> - Reduced emissions from energy use in the process of resource extraction, agriculture, good production and distribution, and waste transportation and treatment - Reduced emissions from fossil fuels by using energy recovered from waste
Industry	<ul style="list-style-type: none"> - Reduced emissions from industrial processes by reducing product demand - Reduced emissions from chemical fertilizer production
Agriculture	<ul style="list-style-type: none"> - Avoided nitrous oxide emissions from farmland by reducing use of chemical fertilizer - Increased soil carbon sequestration
Land use change and forestry	<ul style="list-style-type: none"> - Reduced emissions from mining and deforestation

GHG emissions reduction through improved MSW in Thailand

- **Life cycle approach used as a tool for evaluation**
 - Waste sector → Methane from open dumping and landfill
→ Carbon dioxide from incineration
 - Energy sector → Fuel, incineration (electricity generation)
 - Industrial sector → Production
 - Agriculture sector → Chemical fertiliser use
- **Compared the emission reduction with conventional sanitary landfill (without gas recovery)**

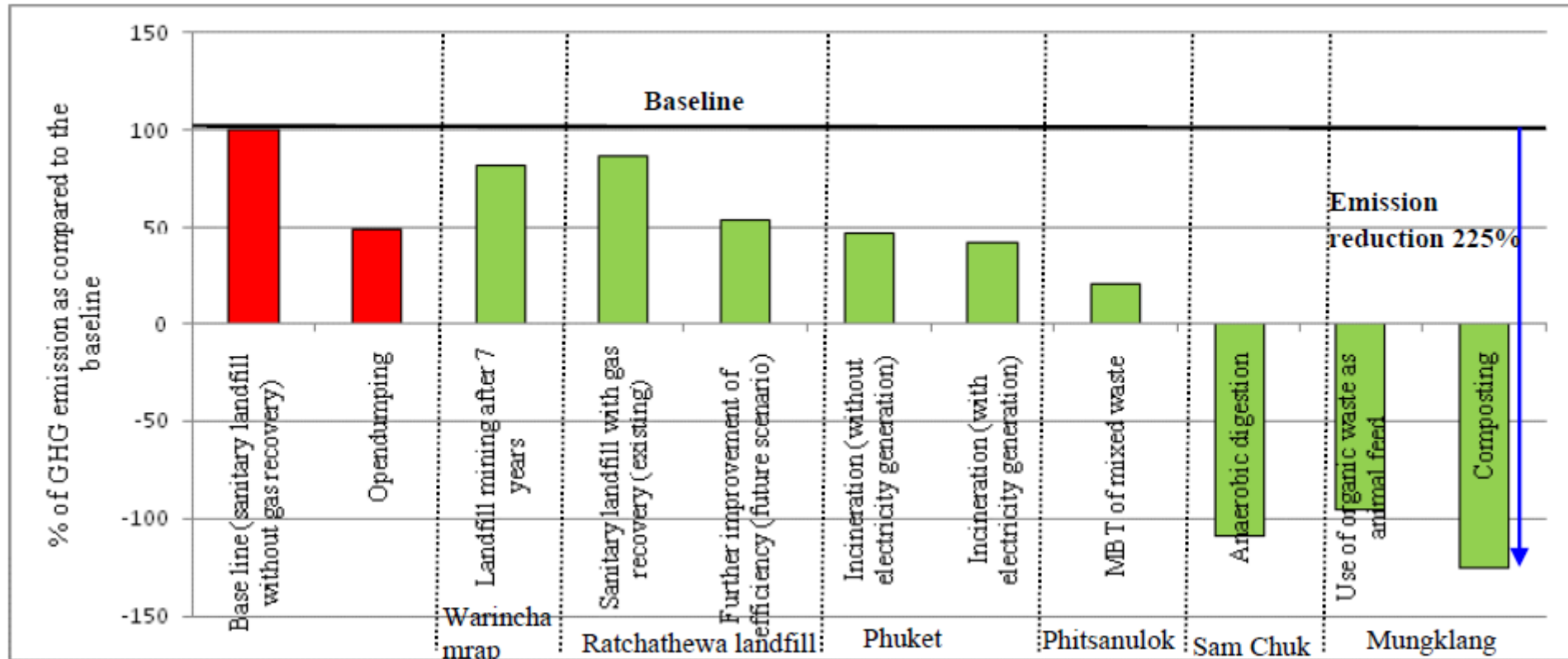
GHG emission on the waste sector of SWM in Thailand- not LCA



Baseline for mixed waste management is sanitary landfilling of mixed waste without gas recovery.

The baseline of organic waste utilisation is sanitary landfilling of organic waste without gas recovery

GHG emissions from SWM in Thailand- LCA perspective



Baseline for mixed waste management is sanitary landfilling of mixed waste without gas recovery.

The baseline of organic waste utilisation is sanitary landfilling of organic waste without gas recovery

GHG emissions from material recycling in Thailand- LCA perspective

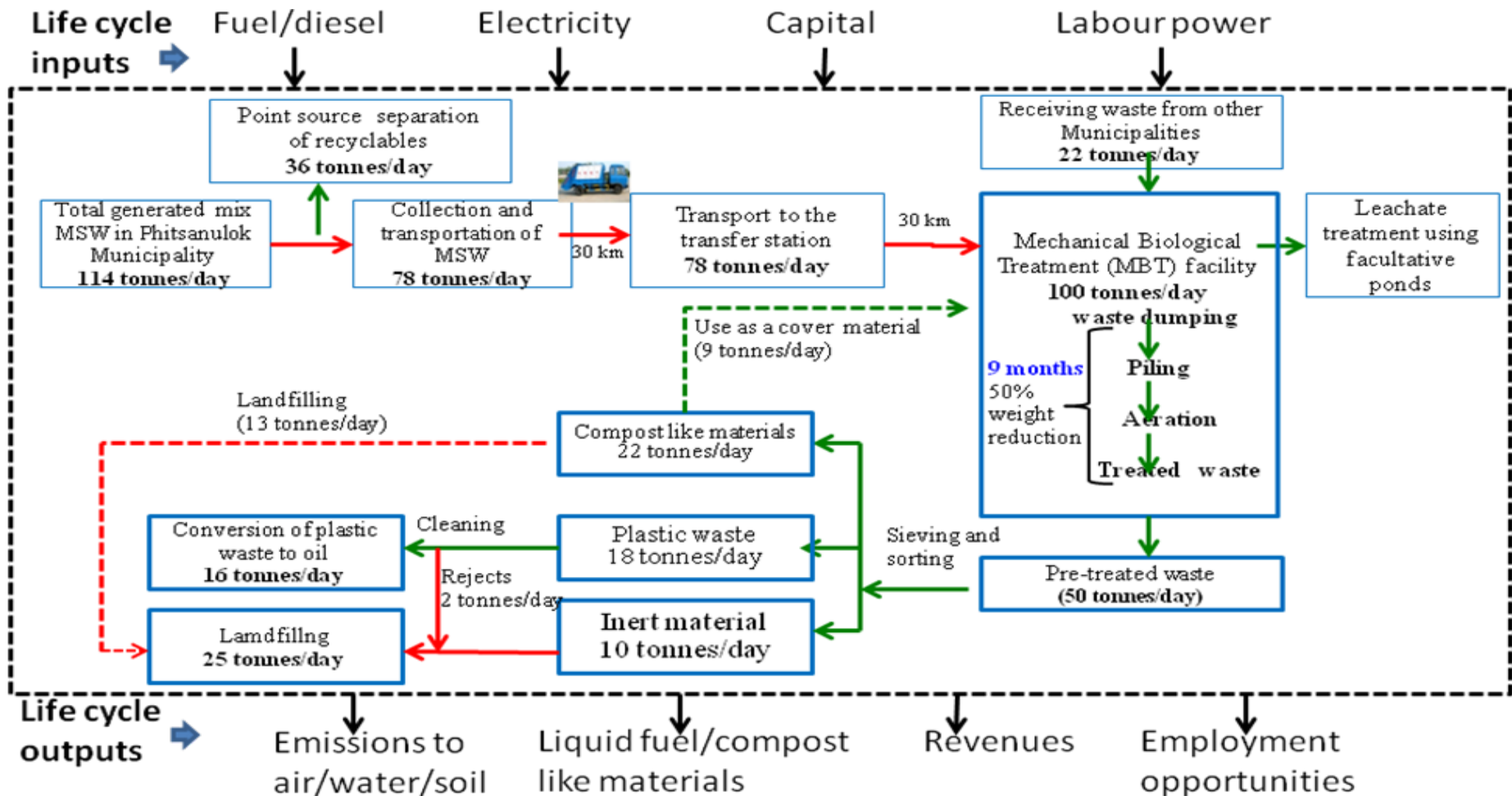
Type of recyclables	GHG emissions from recycling ¹ (A)	GHG emissions avoidance from virgin process ¹ (B)	GHG emissions avoidance from sanitary landfill (C)	Net emissions from recycling (D) = (A)-(B)-(C)
	Unit : (tCO ₂ -eq/tonne of waste)			
Paper	1.27	0.97	2.38	-2.08
Plastic	2.15	1.90	0	0.25
Aluminium	0.39	12.47	0	-12.08
Steel	1.10	2.95	0	-1.85
Glass	0.57	1.03	0	-0.46

Source: ¹Menikpura, 2011

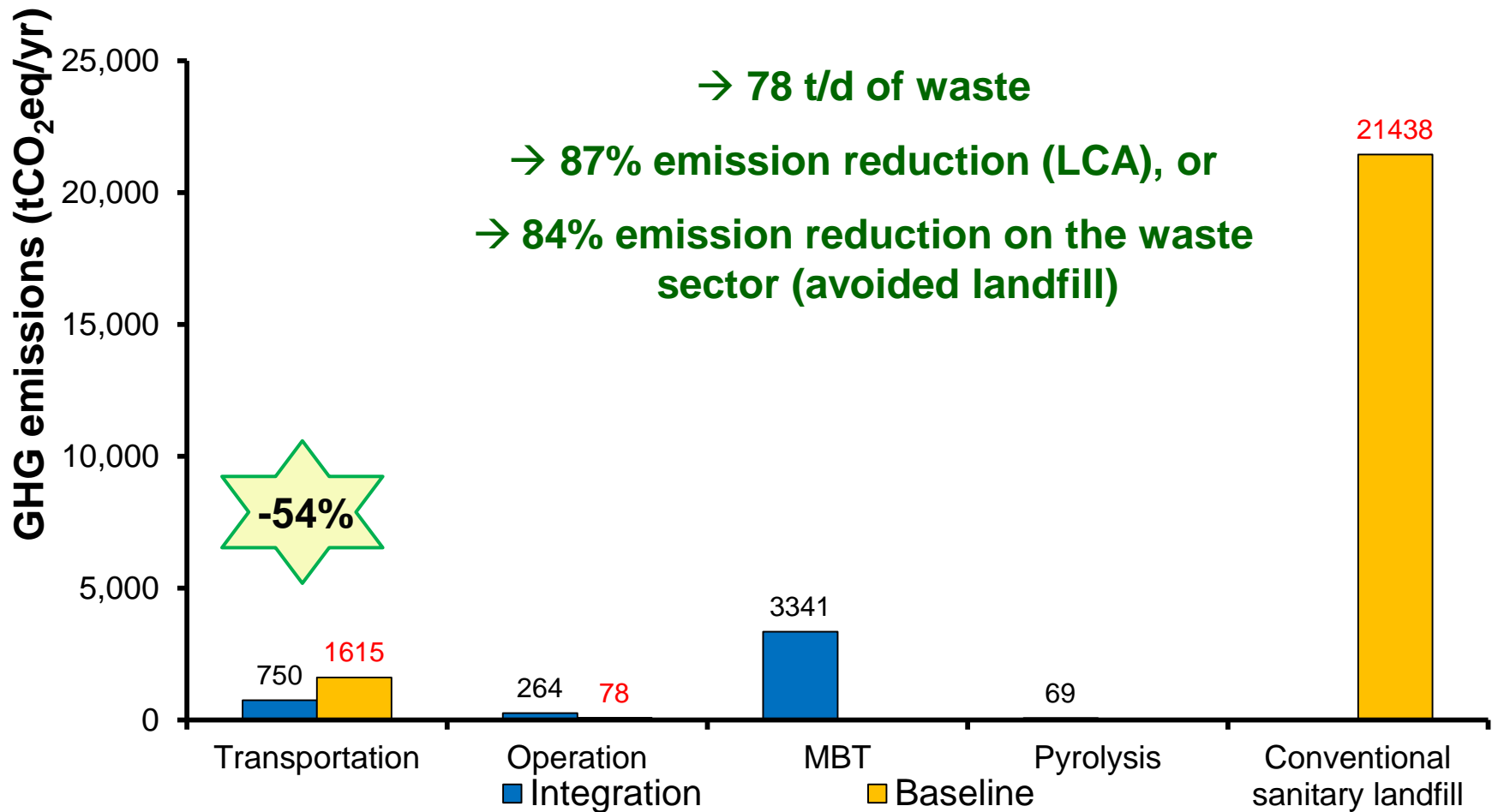
Best practice on SWM and climate change mitigation in Thailand: Phitsanulok Municipality

- **Public participation → Community based management**
 - Residents separated recyclables for sale
 - Residents conduct household and community organic waste management
 - Composting, anaerobic digestion, animal feed
 - Municipality applies the Mechanical Biological Treatment (MBT) prior to landfill disposal
 - Municipality uses of NGV to minimise cost of fuel consumption
 - Municipality introduces the Polluter Pay Principle

Flowchart of solid waste management in Phitsanulok Municipality



Summary of GHG emissions from integrated waste management system in Phitsanulok Municipality



GHG emissions from material recycling (rough estimation)

Recyclables	Weight (t/d)	GHG emissions per tonne (tCO ₂ eq)	Total emissions (tCO ₂ eq/d)
Paper	8.7	-2.08	-18.0
Plastic	5.4	0.25	1.4
Aluminium	1.4	-12.08	-17.4
Steel	5.0	-1.85	-9.3
Glass	15.5	-0.46	-7.1
Net	36		-50.5

Phitsanulok Municipality contributes to avoidance 50.5 tCO₂eq/day when compare with non-recycling

If this emission is included, the Municipality can achieve zero GHG emissions (LCA).

Note: Suchada et al., (2003), approximate composition of collected recyclables by various participants in the municipality is 24% paper, 15% plastic, 43% glass, 4% aluminum and 14% steel.

The 3Rs policies in developing Asian countries

- **Improved solid waste management policy**
 - National 3R strategies, integrated solid waste management
 - Philippines, Malaysia, Viet Nam, China, Cambodia, Bangladesh, Indonesia, Thailand, etc.
- **Climate change mitigation action policy**
 - Avoiding GHG emission from the waste sector
 - China, India, Indonesia, Thailand and the Philippines, etc

Opportunities

- Existing of national 3R policies in many countries
- Existing of 3R practices by local governments
- Existing of various 3R technologies in countries
- Local governments can choose technologies and scale of implementation based on the local context
- Contribution to national agenda on food security, energy security, poverty reduction, etc.
- GHG calculation tool for local governments is existed and publicly downloadable through IGES website

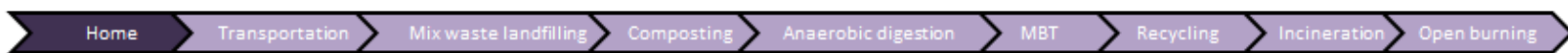
Challenges

- Difficult to directly quantify GHG emission reduction from reduction and reusing
- Local governments has limited capacity on data collection and quantification of GHG emission reduction
 - Should provide training to local governments
- How to measure, report and verify from local to national levels
 - Should develop national framework for MRV
- Financial accessibility and incentives
 - Should set up a financial scheme or crediting system for NAMAs implementation

IGES capacity building supports

- Awareness raising on waste management and climate change
- GHG calculation tool in local language
- Training on GHG quantification
- Guideline on promoting organic waste utilization for climate change mitigation
- Facilitating city-to-city cooperation (North-South-South) for reducing GHG emission reduction from solid waste management

IGES GHG quantification tool – waste management



Simulation for quantification of GHG emissions from waste management methods

Version II - December 2013

Please select the country

Please select the climatic zone of your country

Summary of direct and life cycle GHG emissions from waste management in your municipality will be appeared with respect to following activities once you enter the required data in other sheets

Activity	Direct GHG Emissions	Indirect GHG Savings	Net GHG Emissions (LCA)	Unit
Transportation				kg of CO ₂ -eq/tonne of waste
Landfilling of mix MSW				kg of CO ₂ -eq/tonne of mix waste
Composting				kg of CO ₂ -eq/tonne of organic waste
Anaerobic digestion				kg of CO ₂ -eq/tonne of organic waste
Mechanical Biological Treatment (MBT)				kg of CO ₂ -eq/tonne of waste
Recycling				kg of CO ₂ -eq/tonne of mixed recyclables
Incineration				kg of CO ₂ -eq/tonne of incinerated waste
Open burning				kg of CO ₂ -eq/tonne of open burned waste
GHG emission at present				kg of CO ₂ -eq/tonne of collected waste
Total GHG emissions	#VALUE!	#VALUE!	#VALUE!	tonnes of CO₂-eq/monthly managed w

Applicable for national communication

IGES pilot project on MRV of composting projects

- Battambang City, Cambodia and Phitsanulok Municipality, Thailand
- Participatory pilot project implementation on organic waste separation at source for composting for GHG emission reduction
- Measuring and reporting by local government and verifying by IGES

Recommendations

- **3Rs (reduce, reuse, recycle)** is a climate friendly waste management policy that should be adopted Nationally Appropriate Mitigation Actions (NAMAs) to strengthening its implementation for national waste management plan, etc.
- Some municipalities practice 3Rs for minimising the waste to final disposal site, however most municipalities do not understand the linkage of the 3Rs and global warming. Therefore, **capacity building and awareness raising** are important to achieve the GHG emission reduction goal of the NAMAs.
- In addition, **subsidies to landfill development should be minimised**, unless the 3Rs is integrated to the project.

Thank you very much for your attention

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for further information, progress and final reports.