Decentralized and Integrated Municipal Solid Waste Management

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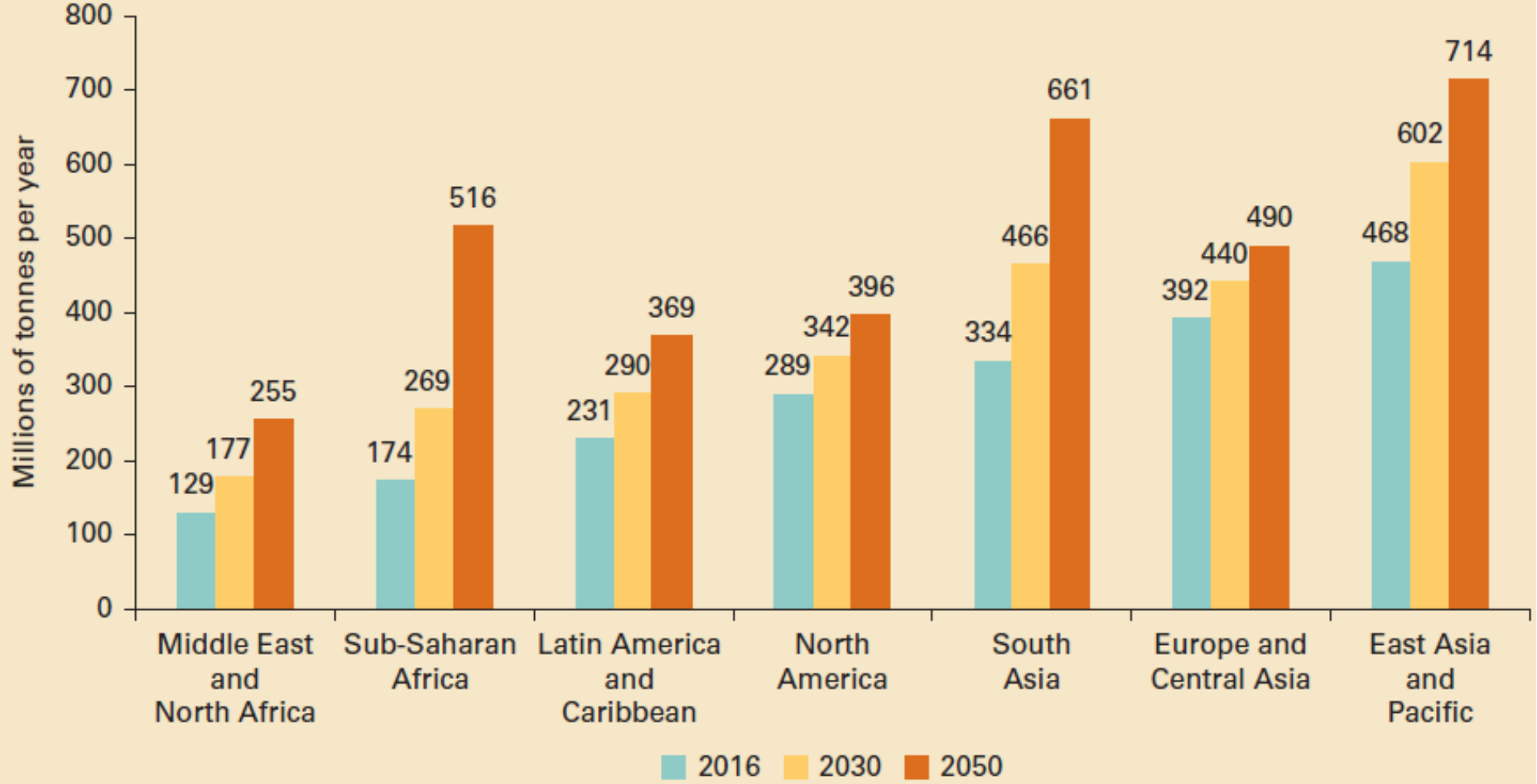
Global solid waste generation: 2016 to 2050 [1]

- 2016 world total : 2.01 billion tonnes per year estimated
- 2030 world total : 2.59 billion tonnes per year projected
- 2050 world total : 3.40 billion tonnes per year projected

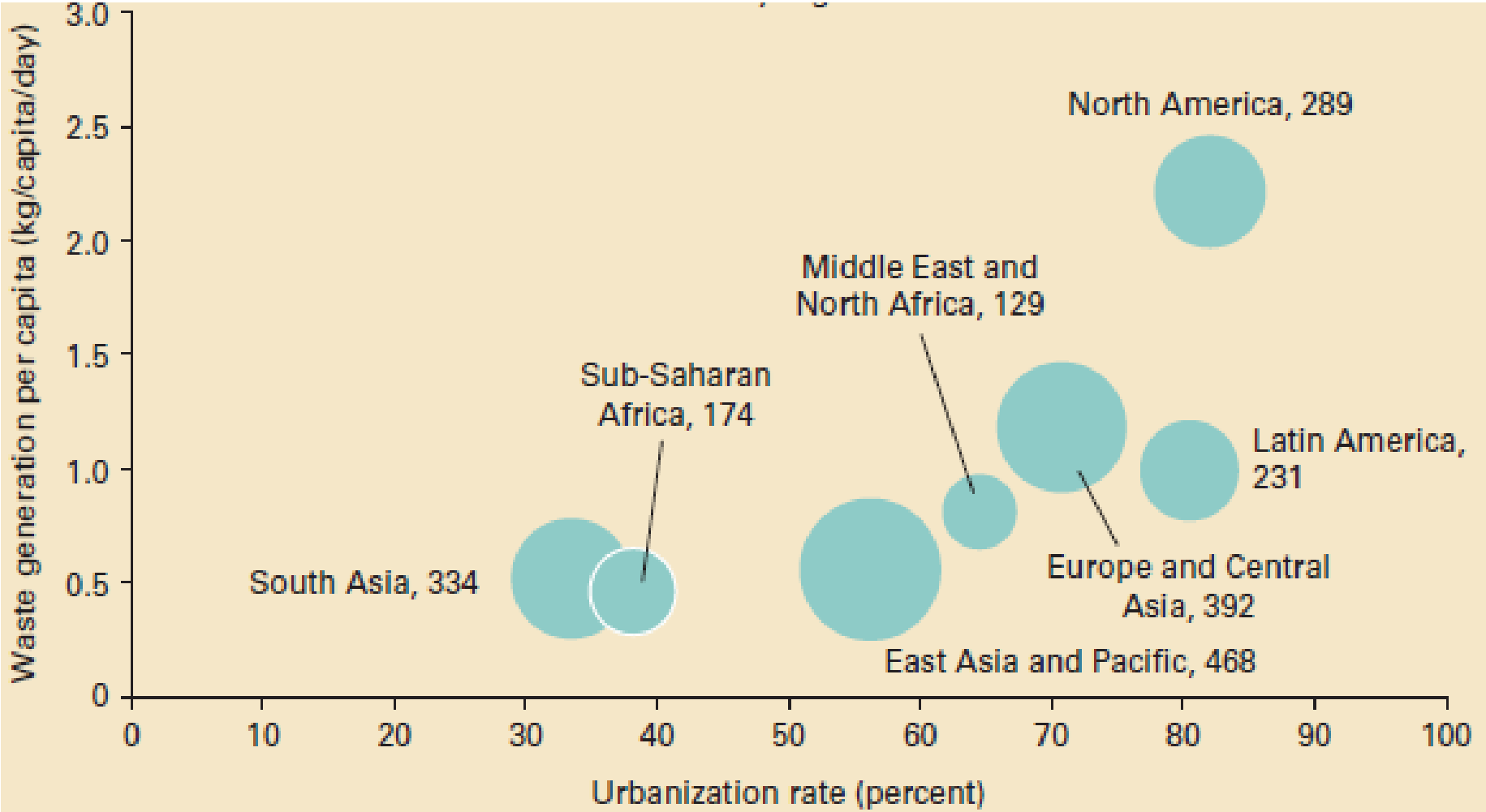


The waste figures are only for municipal sources (residences, public institutions and commercial establishments); the figures do not include construction and demolition waste, hazardous waste, industrial waste, and medical waste.

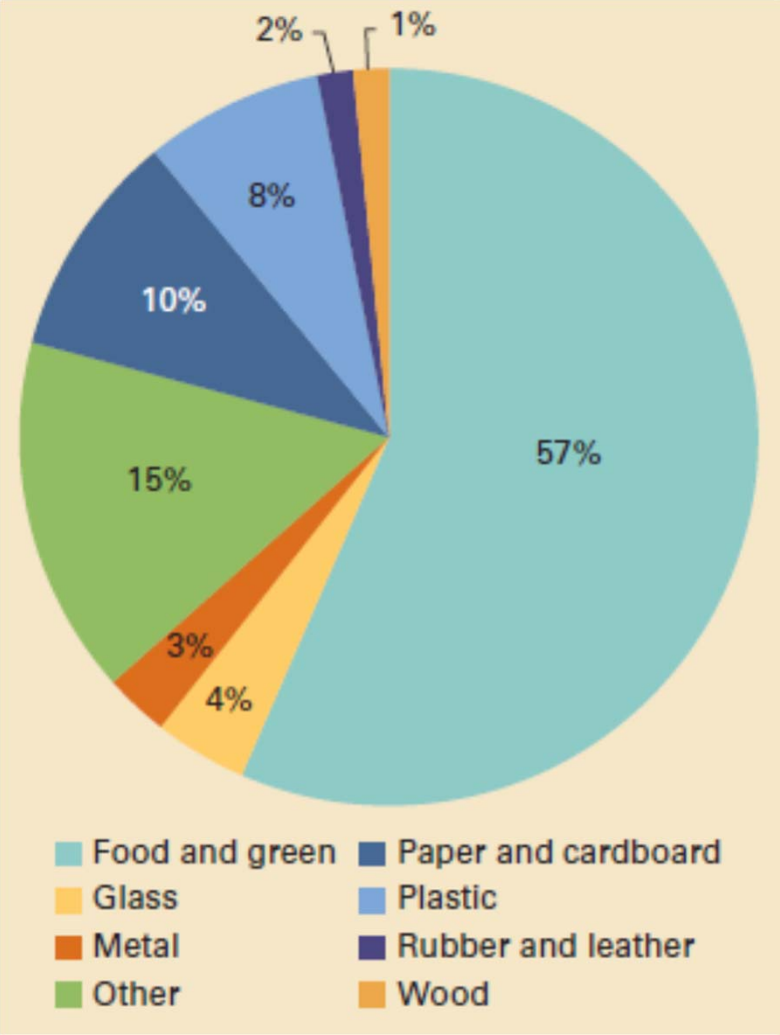
Aspects of solid waste generation

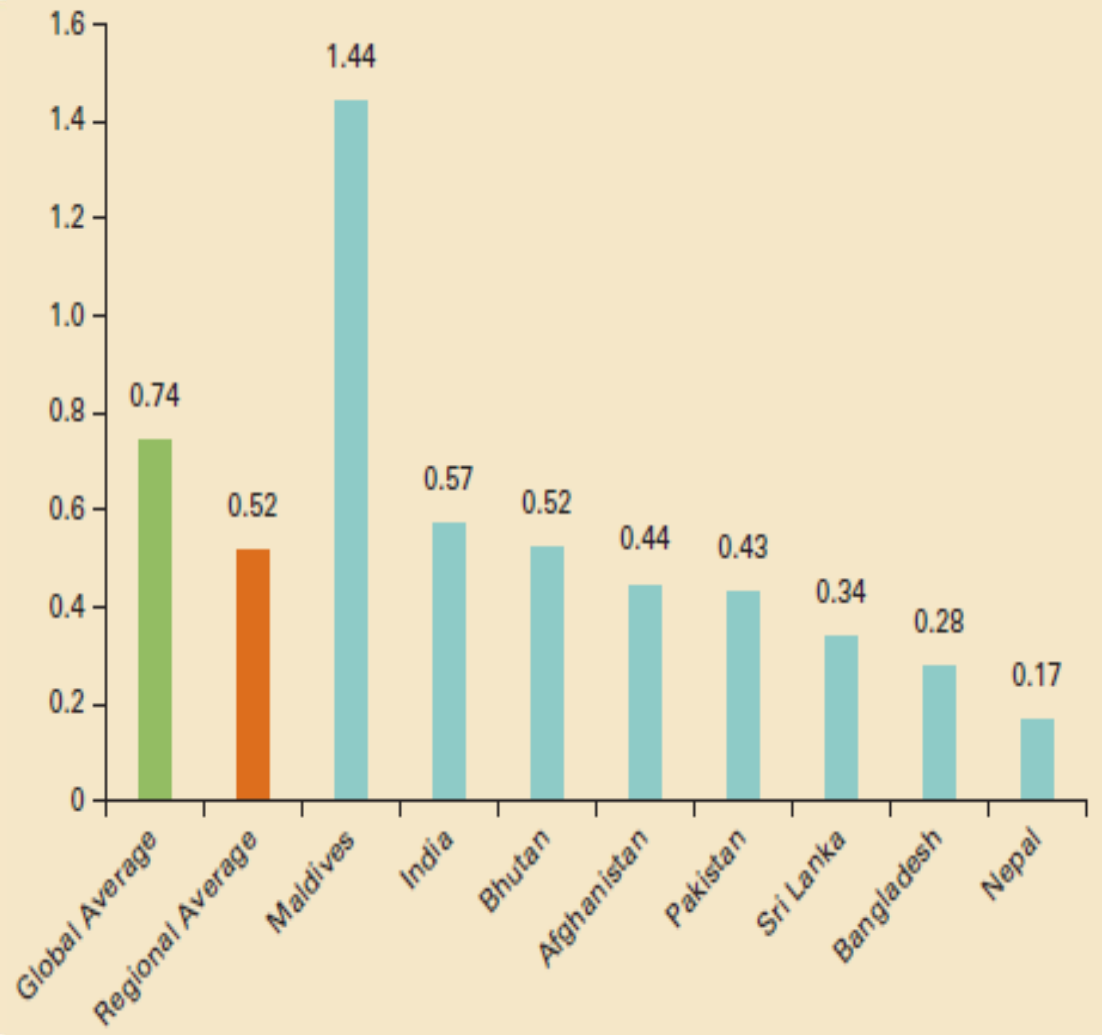
- As ***we*** become ***more affluent***, we not only consume more resources, but also produce ***more waste***.
- As our ***societies urbanize***, we produce ***more waste***.
- As our ***world*** becomes ***more industrialized*** and urbanized, more and ***more of our waste is non-biodegradable***.
- We produce about ***300 million tonnes of plastic every year***, equivalent to the weight of the humans on the planet. [2]
- Municipal solid waste alone produces ***5 percent of global emissions or 1.6 billion tons of CO_2-equivalent.*** This will be ***2.6 billion tonnes of CO_2-equivalent by 2050***. [1]
- Open dumping, landfilling, and incineration, are the main methods of waste management globally. ***In several low-income countries, less than half of municipal solid waste is collected***.
- Our global oceans are now becoming the largest unmanaged waste dump. It is estimated that ***by 2050, there will be more plastic in oceans than fish (by weight).***[3]

Waste and urbanization regional distribution (2016) [1]

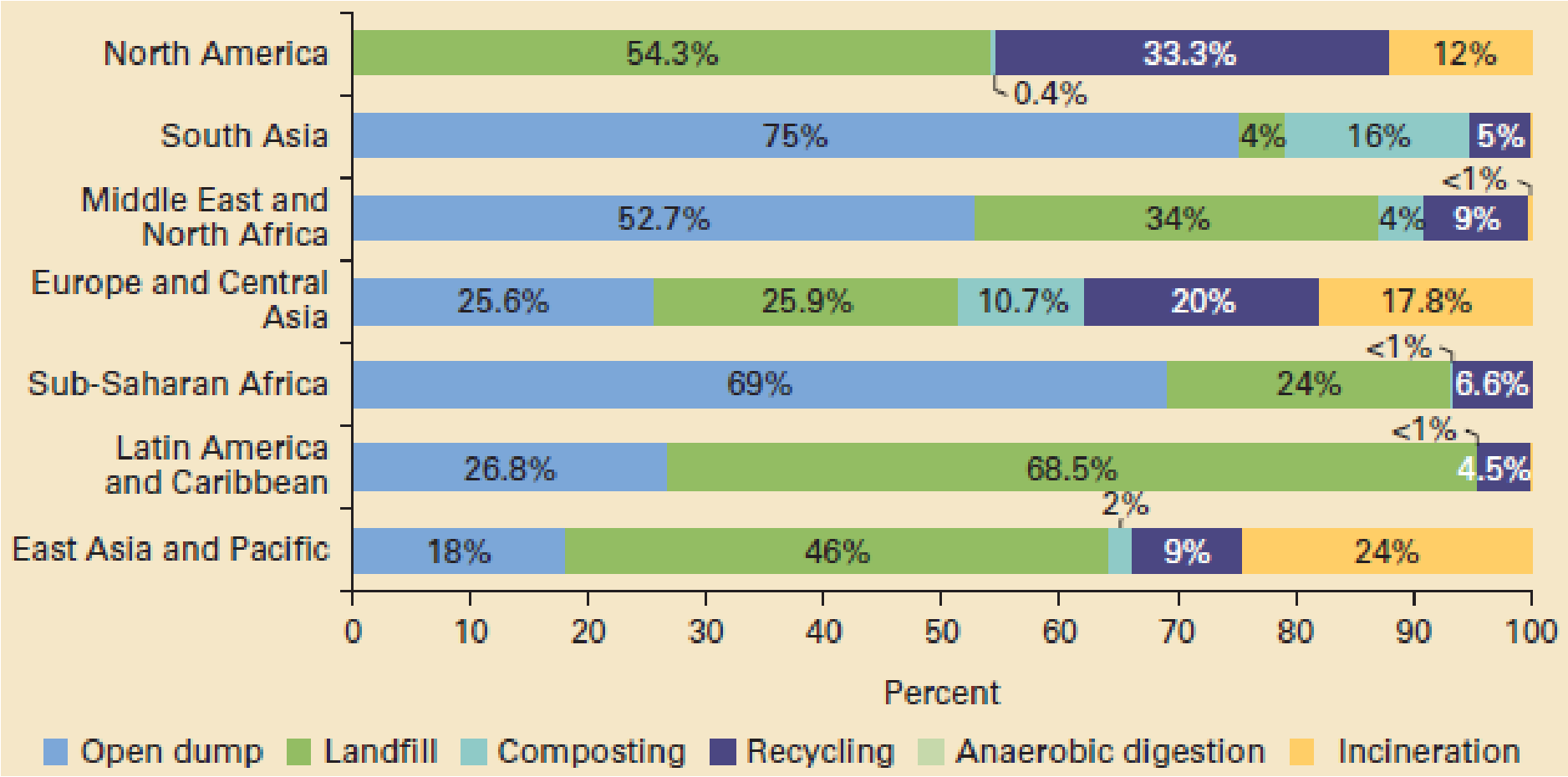


South Asia: solid waste generation (kilogram/person/day) and waste composition (2016) [1]

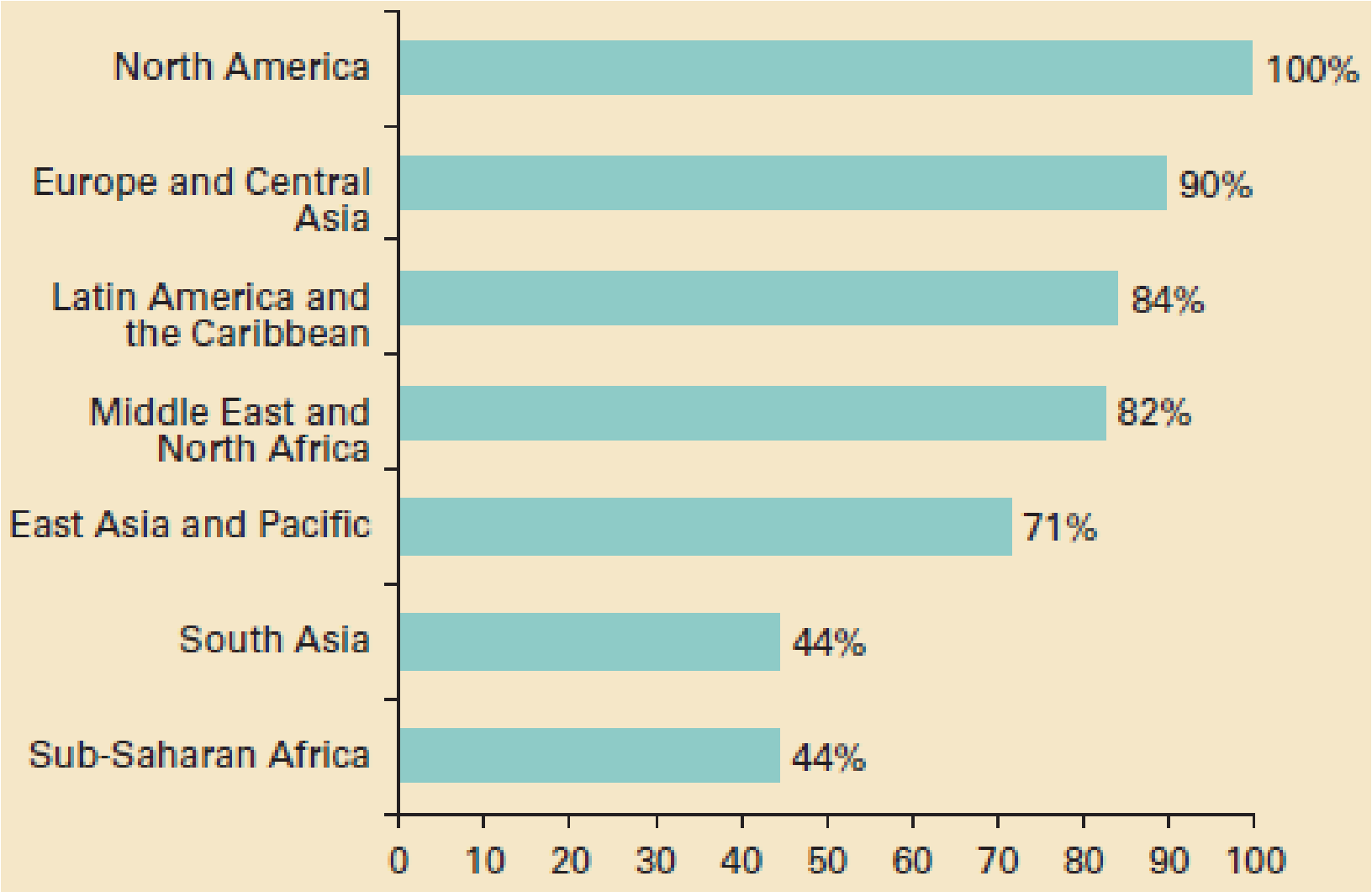




Solid waste disposal/management methods by region (2016) [1]



Solid waste collection rates by region (2016) [1]



Urban solid waste management challenges [4]

Political issues related to waste management

- SWM is seen as difficult/untenable, with unclear entry points
- Lack of skilled personnel in governments with knowledge of developing useful policies and regulations, and multi-stakeholder partnerships
- No clear analysis of potential economic gains from improving waste recovery and mitigation, and of long term societal costs from not sustainably managing waste
- No clear information of locally appropriate solutions for waste management (low cost, low technology, decentralized)
- Lack of financial resources and technical or managerial capacity (in low income and lower middle income countries)
- Lack of private interest in investing in waste recovery due to no enabling policy and regulatory environment

The waste problem cannot be solved 'at the last minute' or by 'business-as-usual' approach; it requires integrated planning, with a multi-stakeholder approach, capacity building activities, and clear short and long term goals.

Social-economic issues related to waste management

- Grave ongoing health impacts from air, water, and soil pollution due to unsustainably managed waste
- Poor people are most affected – they live close to or work on open dumpsites
- Significant ecological and economic resources being lost in unrecovered waste (especially in the organic fraction of waste)
- High present and future costs to society – waste collection and disposal, health treatment, environmental remediation, strengthening of social-ecological resilience, climate change mitigation and adaptation
- Lack of public awareness of and participation in 3R (Reduce, reuse, recover/recycle; in addition refuse & redesign products)
- Private sector investment is low due to unfavorable policy environment
- Unsustainable waste management inhibits local and national efforts to develop sustainably (SDGs, NDCs, NUA)

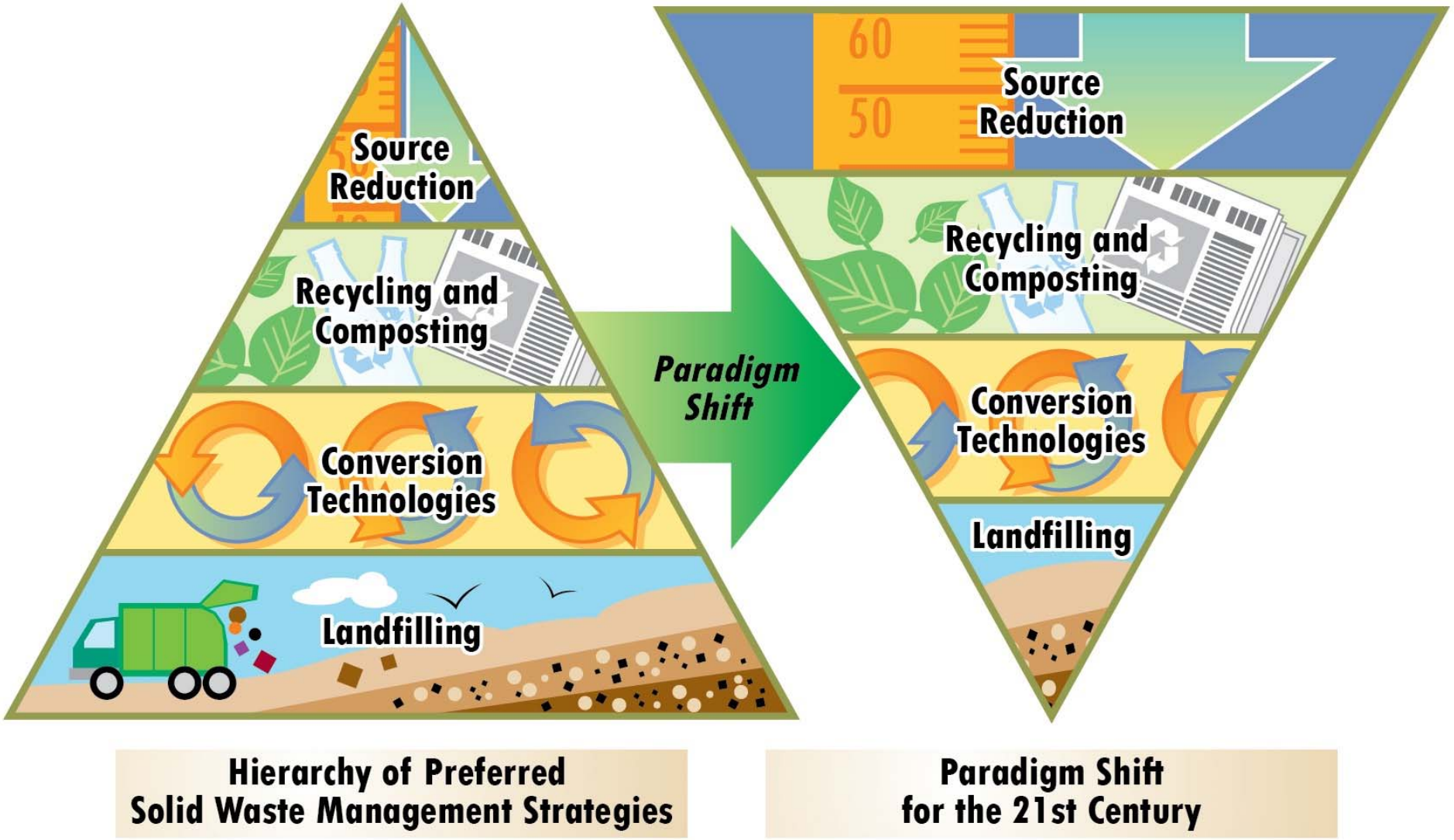
People are the consumers of resources, designers of products, and the producers of waste. Their awareness building and participation is essential to SWM.

Technological issues related to waste management

- Applied technologies are often not locally appropriate and result in large trade-offs
- Focus is on large end-of-pipe solutions – collect and dump or burn – not on decentralized solutions that recover value and reduce waste at source
- No focus on building awareness among waste generators to reduce waste at source or participate in 3R practices
- Technology transfer (North-South-South) can be costly and entail outdated or unsustainable solutions
- No local capacity building of waste managers to efficiently manage/operate the technology, which increases dependency on solutions providers and increases costs/failure rates
- Planning for technological applications does not focus on enhancing local circular economy and social-ecological resilience

Waste management technologies should be locally appropriate and generate local employment and revenue; the local government should have the capacity to assess and efficiently use technologies to recover ecological and economic value.

Paradigm shift in solid waste management [5]



Solid Waste Management - an integrated and multi-stakeholder approach [4]

IRRC and SDGs [4]

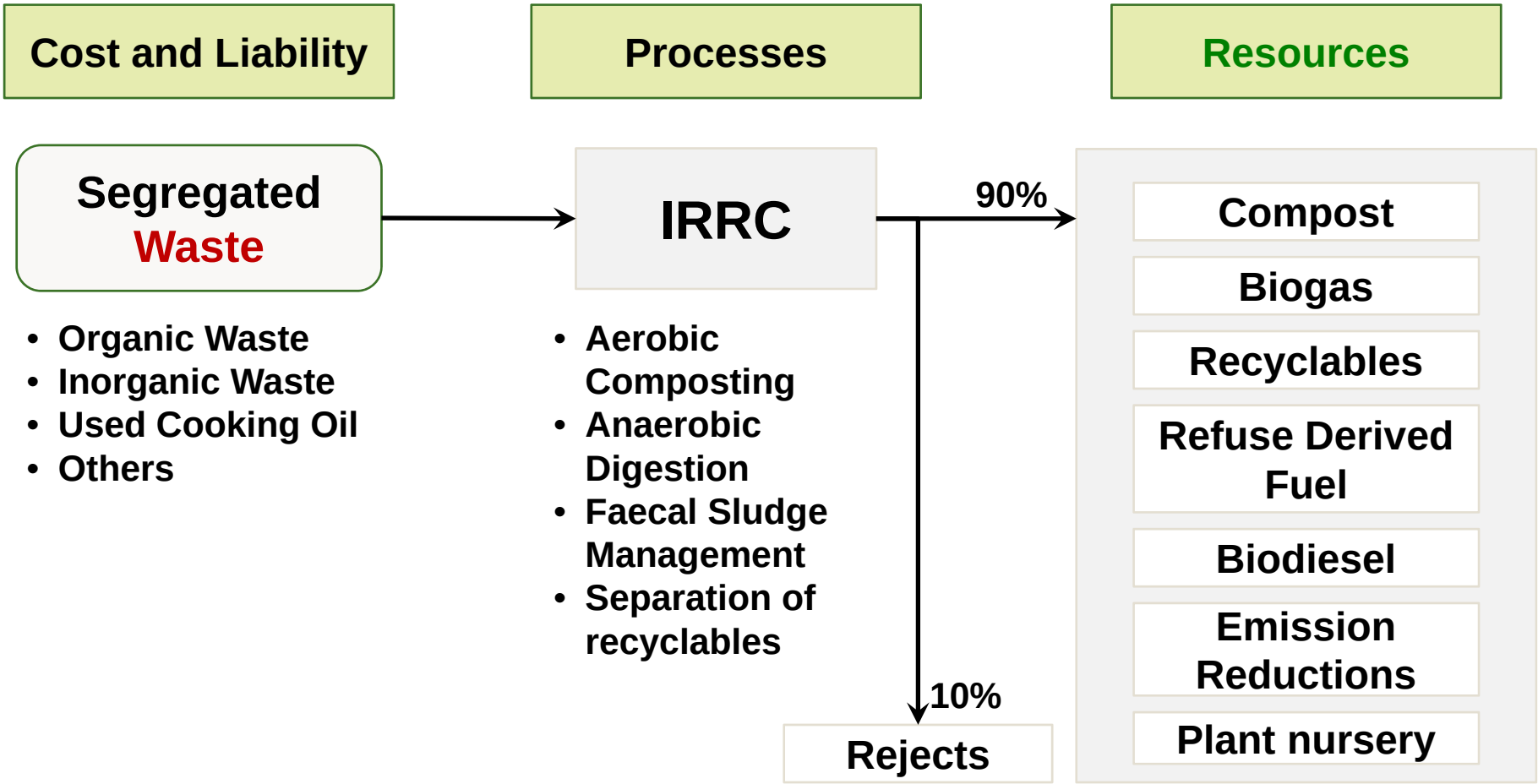
Different partners – Different resources

Community	*Municipal/Provincial*	*National/International*
Households • Separated waste	**Municipal government** • Regulatory power • Public funds, resources • Waste collection	**National government** • Regulatory power • Market intervention • Public funds, resources
Civil society organization • Community access		
Ward governments • Community trust	**Waste company** • Facility operations	**Multilateral and bilateral development agencies** • Networking • Technical knowledge • Climate financing
Waste pickers • Access to waste • Market knowledge	**Provincial government** • Regulatory power	

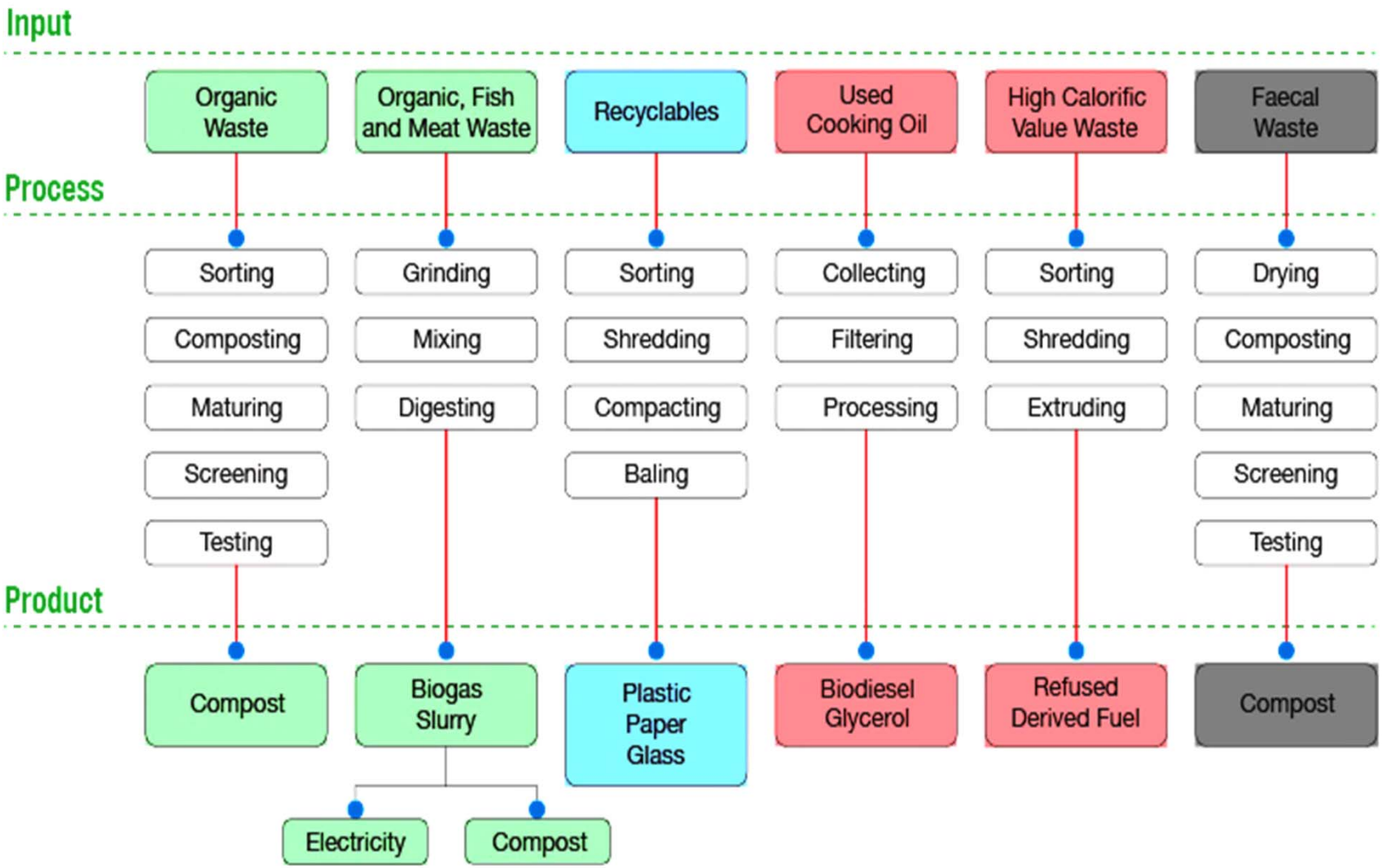
IRRC: A pioneering solution

- An **Integrated Resource Recovery Center (IRRC)** is a recycling facility where a significant portion (80-90%) of waste can be processed in proximity to the **source** of generation, and in a **decentralized** manner. The IRRC concept is based on the reduce, reuse and recycle (3R) principles
- The **Integrated Resource Recovery Center** model was developed by Waste Concern, an NGO based in Dhaka
- The model is **cost-effective, affordable, low-tech and community-based**, and allows transforming waste into various types of resources

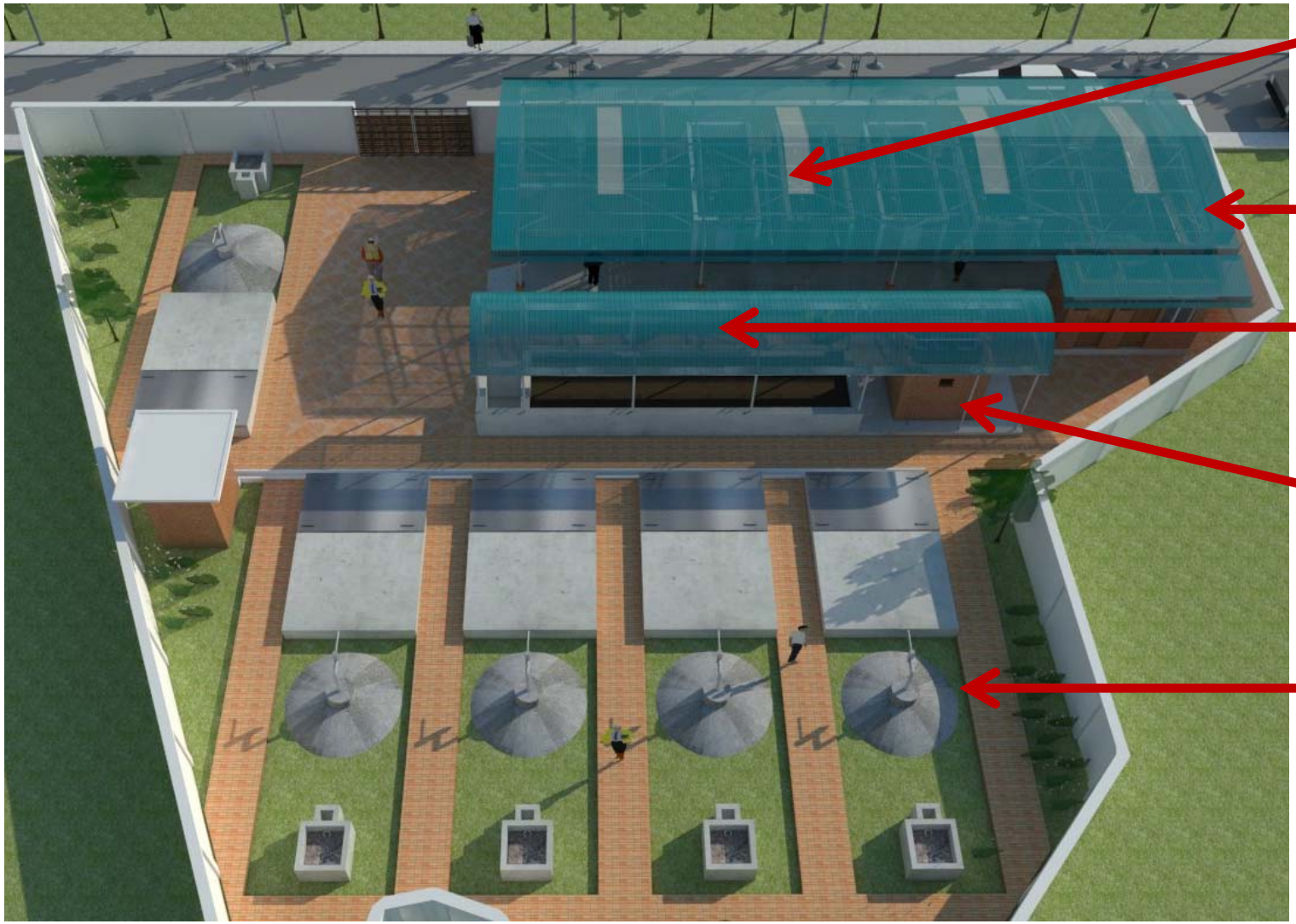
IRRC: Turning Waste into Resources



IRRC material flows [6]



IRRC: Aerial view 6



IRRC: Aerial view 6

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Economic benefits from IRRCs

Reduced landfilling costs

Extended landfill life

Reduced subsidy for chemical fertiliser

Improved crop yields

Social benefits from IRRCs

Better job opportunities

Improved living conditions

Reduced disease

Improved ecological awareness

Environmental benefits from IRRCs

Reduced pollution

Reduced greenhouse gas emissions

Improved soil quality

Low-carbon fuel

Capital and Operational Estimates for IRRCs

Activity	IRRC with composting and recyclables	IRRC with Anaerobic Digestion (biogas)
Land requirement	150-200 m^2 per ton of waste	400-500 m^2 per ton of waste
Waste required	High quality organic waste required; cost of segregation	High quality organic waste required; cost of segregation
Technical training & capacity building for establishing policies and programs	USD 5,000 to USD 10,000 per 1 to 2 tons of waste	USD 5,000 to USD 10,000 per 1 to2 tons of waste
Community awareness building, & waste separation advocacy programs	USD 5,000 to USD 10,000 per 1 to 2 tons of waste	USD 5,000 to USD 10,000 per 1 to2 tons of waste
Permits, surveys, assessments	USD 10,000 to USD 15,000	USD 10,000 to USD 15,000
Establishment of IRRC (CAPEX)	USD 20,000 to USD 30,000 per ton of waste	USD 30,000 to USD 40,000 per ton of waste
Operation of IRRC (electricity, waste, staff, maintenance) (OPEX)	USD 2,000 to USD 3,000 /ton/year (about 10% of CAPEX)	USD 3,000 to USD 4,000 /ton/year (about 10% of CAPEX)

Economic Benefits of IRRCs (composting only)

Benefit	Type	Value (US$)		
		Bangladesh	Sri Lanka	Viet Nam
Job creation: additional income for waste-pickers employed	Social/Economic – Public & Private	3.76	3.00	N/A
Cost savings for the municipality for avoided landfilling of waste	Economic – Public	11.68	28.75	34.85
Savings in chemical fertilizer use (25% reduction)	Economic/Environ-mental – Private & Public	4.85	1.13	10.54
Savings in subsidy to chemical fertilizers	Economic – Public	2.07	2.74	N/A
Increase in crop yields	Economic – Private & Public	24.55	21.52	46.71
	TOTAL	**46.91**	**57.14**	**92.10**

All values are in USD, for composting of 1 ton of organic waste; *Source: ESCAP and Waste Concern*

Sources of information

[1.] Kaza, Silpa, Lisa Yao, Perinaz Bhada-Tata, and Frank Van Woerden. 2018. *What a Waste 2.0: A Global Snapshot of Solid Waste Management to 2050*. Urban Development Series. Washington, DC: World Bank. doi:10.1596/978-1-4648-1329-0. License: Creative Commons Attribution CC BY 3.0 IGO

[2.] United Nations Environment Progamme. 2018. Access here: https://www.unenvironment.org/interactive/beat-plastic-pollution/

[3.] Ellen MacArthur Foundation. 2016. The New Plastics Economy—Rethinking the Future of Plastics. Cowes, UK: Ellen MacArthur Foundation. https://www.ellenmacarthurfoundation.org/assets/downloads/EllenMacArthurFoundation_TheNewPlasticsEconomy_Pages.pdf

[4.] United Nations Economic and Social Commission for Asia and the Pacific. 2017. *Sustainable development benefits of Integrated Waste Management*

[5]. Evolution of Integrated Solid Waste Management Systems Enhanced with Municipal Utilities and Green Energy Production. Accessed here: https://wasteadvantagemag.com/evolution-of-integrated-solid-waste-management-systems-enhanced-with-municipal-utilities-and-green-energy-production/

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[7]. United Nations Economic and Social Commission for Asia and the Pacific. *Integrated Resource Recovery Centers*