

MANAGEMENT OF SOLID WASTE

Prof. Dr. Turgut T. Onay

Boğaziçi University

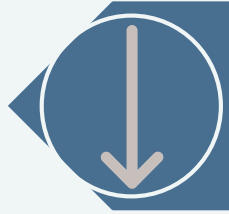


Outline

- Introduction
- Types and Characteristics of Solid Waste
- Waste Management
- Current Situation
- Featured Applications
- Problems Encountered in Waste Management in Different Sectors

INTRODUCTION

Principles of Waste Management



Prevention and reduction of waste production and its harms



Using methods and processes that will not harm the environment and human health



Separate collection of waste at source



Waste collection by authorized people and transportation with licensed vehicles



Principles of Waste Management



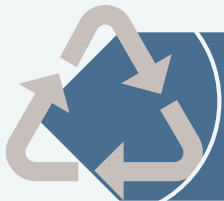
Disposal or recovery of waste by a licensed facility



Disposal of waste at the nearest and most suitable facility



Using environmentally compatible technologies



Recycling waste or using it as an energy source



TYPES AND CHARACTERISTICS OF SOLID WASTE

Characteristics of SW

Physical characteristics:

- Specific weight
- Humidity
- Particle size distribution
- Area/Field capacity
- Permeability (Hydraulic conductivity)

Water content of Solid Wastes

Waste Type	Water content, %	Typical value, %
Food	50-80	70
Paper	4-10	6
Cardboard	4-8	5
Plastic	1-4	2
Textile	6-15	10
Wood	15-40	20
Glass	1-4	2
Dust	6-12	7



Waste Types

Domestic
waste

Packaging
waste

Hazardous
waste

Waste
batteries

Medical
waste

Waste
tires

Electronic
waste

WASTE TYPES

Domestic waste

Domestic solid wastes are all kinds of waste that are

- produced as a result of daily activities and
- mostly do not have hazardous or harmful properties.



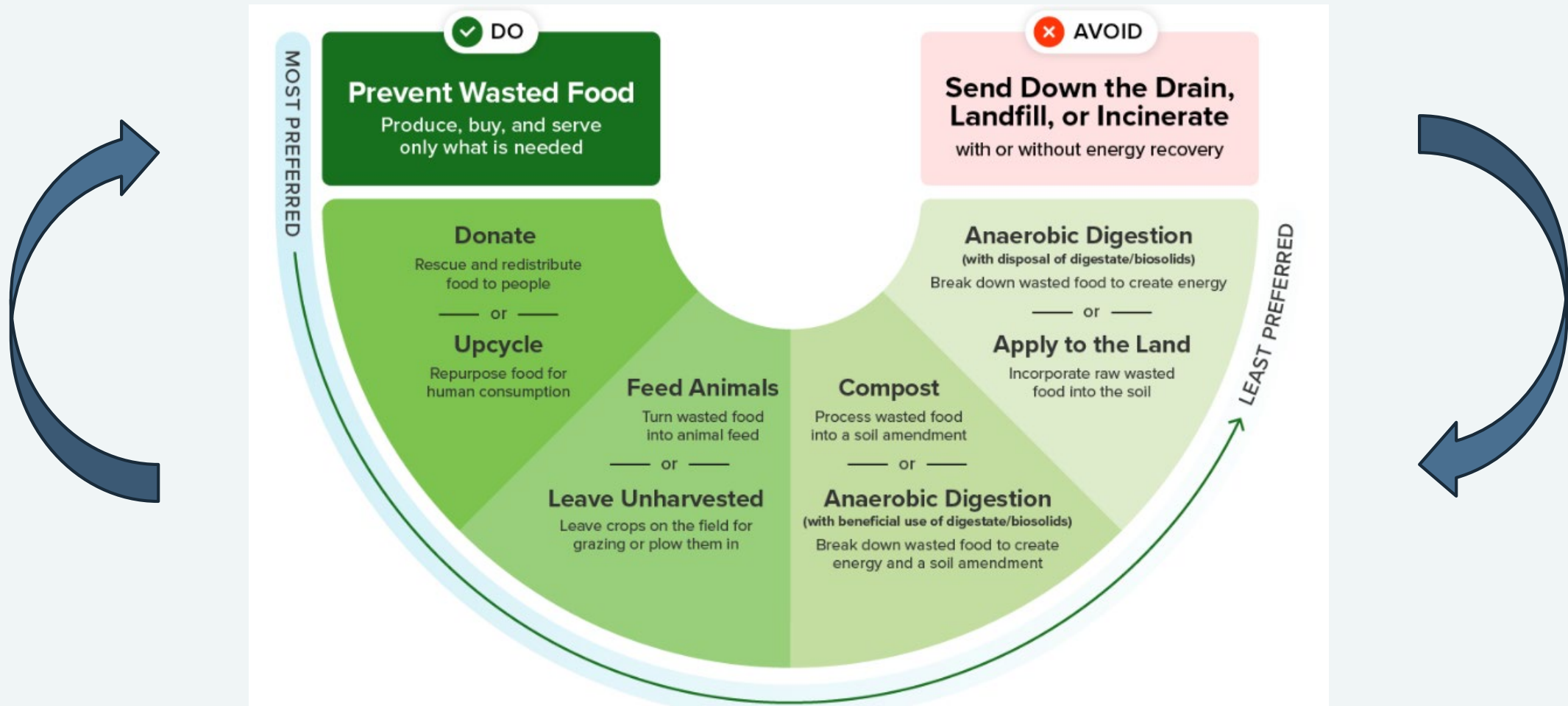


Domestic Waste

- Food waste
- Garden trimmings
- Waste household goods
- Packaging materials
- Textiles
- Waste electronics

EPA's Wasted Food Scale

How to reduce the environmental impacts of wasted food?





WASTE TYPES

Packaging waste

- Paper - cardboard
- Glass bottles and jars
- Metals (cola cans, tin containers, cans)
- Plastics (water, soft drink, oil packaging, detergent containers, etc.)
- Composites (packages such as milk and soft drink cans, soup packages, chips etc.)

WASTE TYPES

Medical waste



These are wastes from hospitals and similar health institutions.

They can be divided into 3 groups:

Pathological Wastes: consisting of tissues, organs, body parts, blood and body fluids.

Sharp Objects : Needle tips, syringes, scalpels, razors, broken glass, etc.

Infectious Waste: Wastes which are known to carry or are likely to carry infectious agents, containing all kinds of body fluids, especially blood and blood products, human tissues, autopsy materials

WASTE TYPES

Hazardous waste

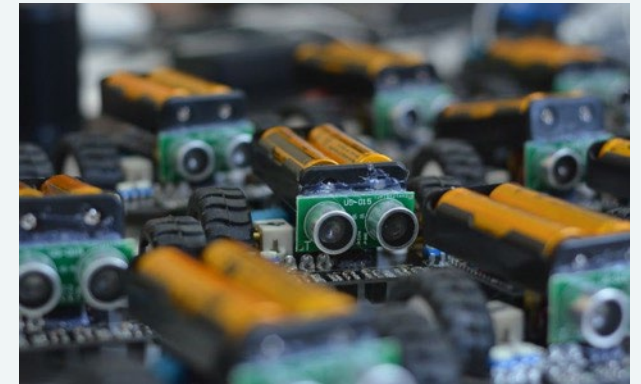


- Carcinogenic,
- Toxic,
- Explosive,
- Flammable,
- Corrosive,
- Irritating

They are wastes that pose a risk to human health and the environment due to such characteristics.

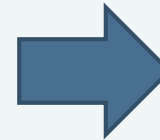
Hazardous waste

- × Packages with hazardous materials (paint cans, chemical containers, oil cans and barrels, etc.)
- × Cloths, gloves, etc. contaminated with hazardous substances.
- × Organic solvents,
- × Old batteries and accumulators,
- × fluorescent lamps,
- × pesticides,
- × Substances containing asbestos,
- × Filter dusts,
- × Hardening salts, etc. containing cyanide.



WASTE TYPES

Electronic waste



Toxic Substances:

- Lead
- Mercury
- Cadmium
- Chromium
- Polybromide Biphenyls (PBB)
- Polybromide Diphenyl Ethers (PBDE)

WASTE TYPES

Waste Batteries

- Used batteries that cannot be reused,
- Batteries that must be collected, transported and disposed of separately from household waste.
- For example; cylindrical battery, button battery etc.



WASTE TYPES

Waste Tires

- Discarded tires that have been determined to have completed their useful life and are removed from the vehicle,
- They are in a condition that they cannot be used on the vehicle again, or
- Discarded tires that occur during production.



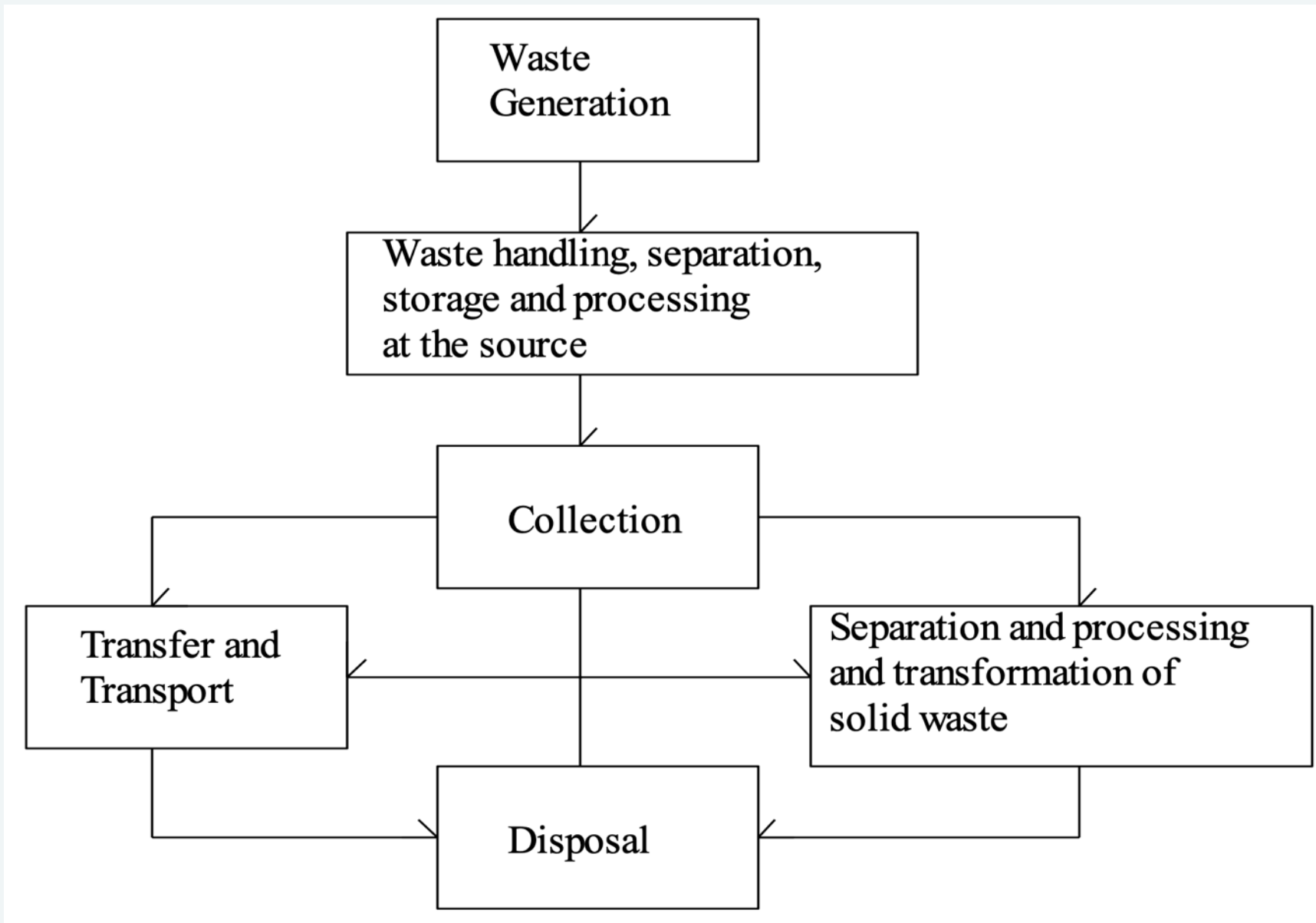
Waste Tires

- It takes half a barrel of crude oil to produce a single truck tire.
- Waste tires cause uncontrolled fires. Due to their high oil content, tire fires can last for months, releasing toxic gases.
- Waste tires create an environment suitable for mosquitoes to live and reproduce, causing the spread of mosquito-borne epidemics.



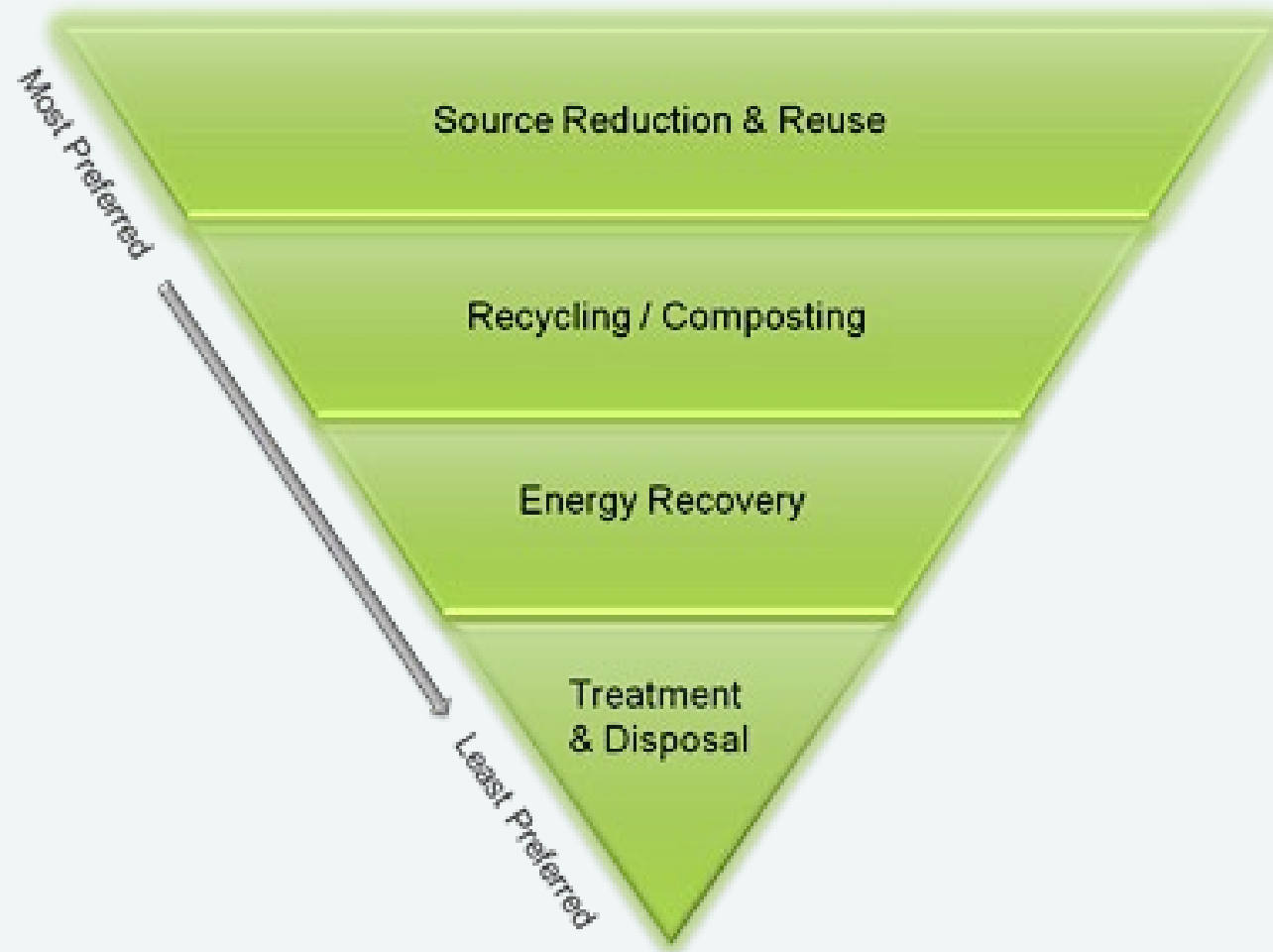


WASTE MANAGEMENT



Waste Management Hierarchy

Waste Management Hierarchy



Waste Reduction

- ✓ Waste reduction or source reduction
- ✓ Practice of preventing waste by decreasing or eliminating the amount of materials initially used.
- ✓ Some examples:
 - ❖ purchasing products in bulk quantities rather than single servings
 - ❖ using reusable serving utensils and trays instead of disposable items etc.



Reuse

- ✓ Reuse is the practice of using a material over and over again in its current form.
- ✓ Preserves some or all of the energy and materials that went into making an item.
- ✓ Donating used household items like books, magazines, clothing, kitchen wares, etc.
- ✓ Using empty food containers to store leftovers or reusing plastic grocery sacks to line trash containers or pick up after pets.



Recycle

- ✓ Recycling is a series of activities that includes
 - ❖ collecting used, reused, or unused items that would otherwise be considered waste;
 - ❖ sorting and processing the recyclable products into raw materials; and
 - ❖ remanufacturing the recycled raw materials into new products.
- ✓ Products should only be recycled if they cannot be reduced or reused.



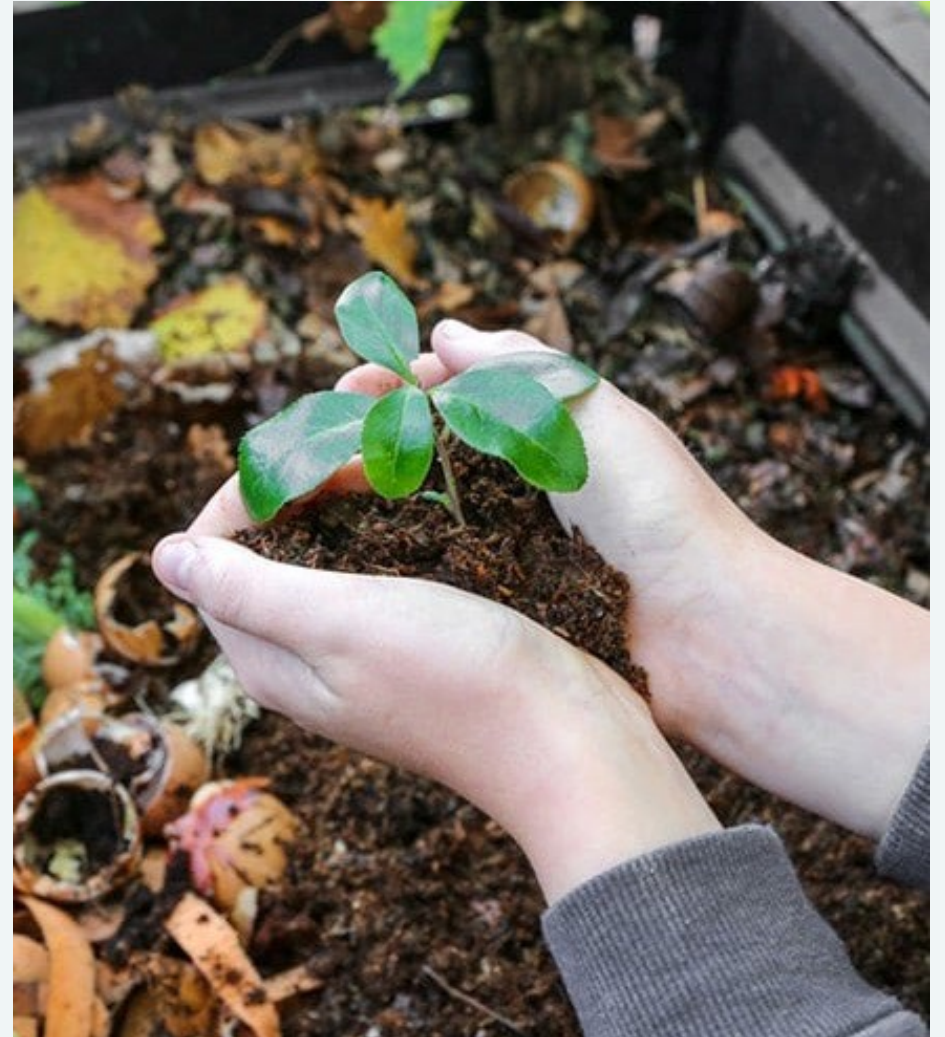
Separate Collection of Waste at Source

- ✓ The collection of individual components of solid waste from any source, usually separated into different collection containers, in order to recover, reuse or recycle the material or to facilitate its collection and disposal.
- ✓ The most important step in the recycling chain is the separate collection of packaging waste from homes.
- ✓ Collecting end-of-life packaging waste separately from organic waste creates a much higher quality collection system.



Composting

- ✓ Compost is the process of decomposing organic materials into simpler organic and inorganic substances.
- ✓ Composting is nature's way of recycling and can occur everywhere in nature and is a nutrient recycling in the ecosystem.
- ✓ A good compost is rich in plant nutrients, organic matter and beneficial organisms.



Recovery

Process of using the components in solid waste more than once by converting them into other products or energy by *physical, chemical and biochemical* methods.

WHAT SAVINGS ARE SITTING IN YOUR OLD REFRIGERATOR?

Recycling your old unit can save **resources, energy, and money.**

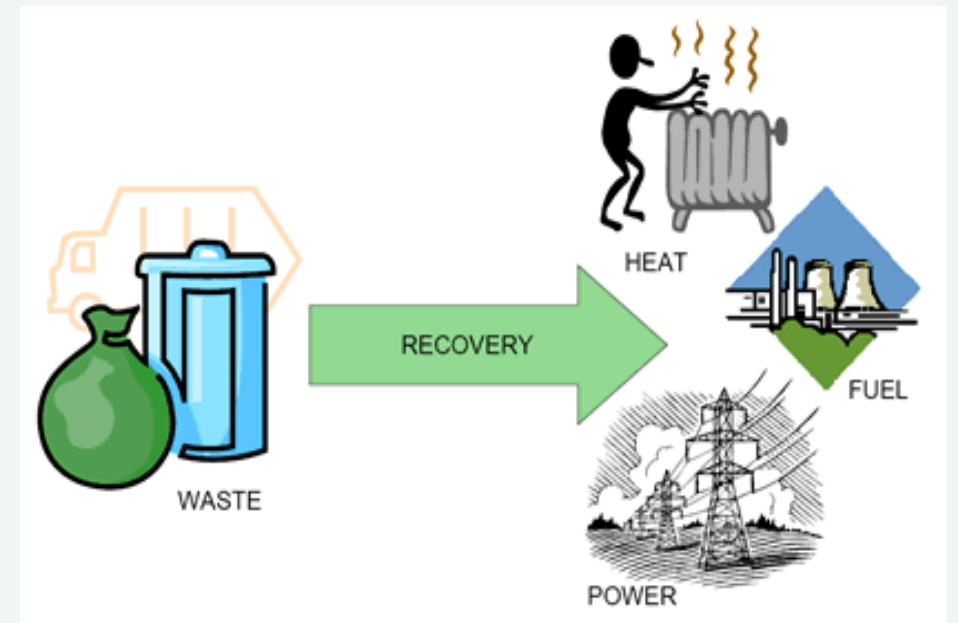
95% of a refrigerator or freezer can be recycled.

A single refrigerator contains ...

- 135 lbs Metal → Metal to building materials
- 11 lbs Plastic → Plastic to consumer goods
- 6 lbs Foam Insulation → Foam to energy
- 4 lbs Glass → Glass to cement

Energy Recovery from Waste

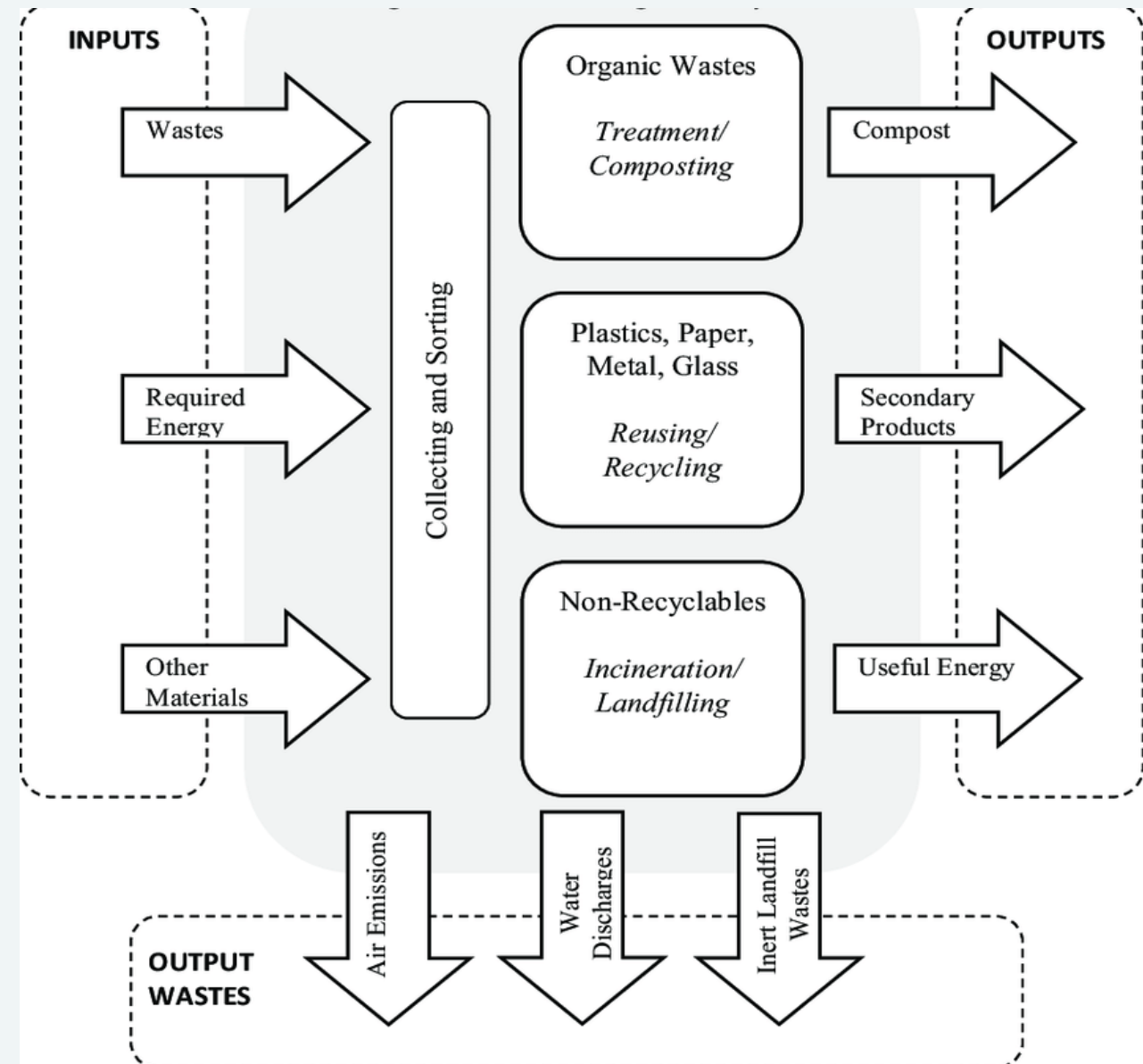
- Conversion of non-recyclable waste materials into useable heat, electricity, or fuel through a variety of processes, including combustion, gasification, pyrolyzation, anaerobic digestion, and landfill gas (LFG) recovery.
- This process is often called waste-to-energy (WTE).
- Converting waste into electricity and heat generates a renewable energy source and reduces carbon emissions and reduces methane generation from landfills.



Integrated Waste Management

- Integrated solid waste management refers to the strategic approach to sustainable management of solid wastes covering all sources and all aspects, covering **generation, segregation, transfer, sorting, treatment, recovery and disposal** in an integrated manner, with an emphasis on maximizing resource use efficiency.

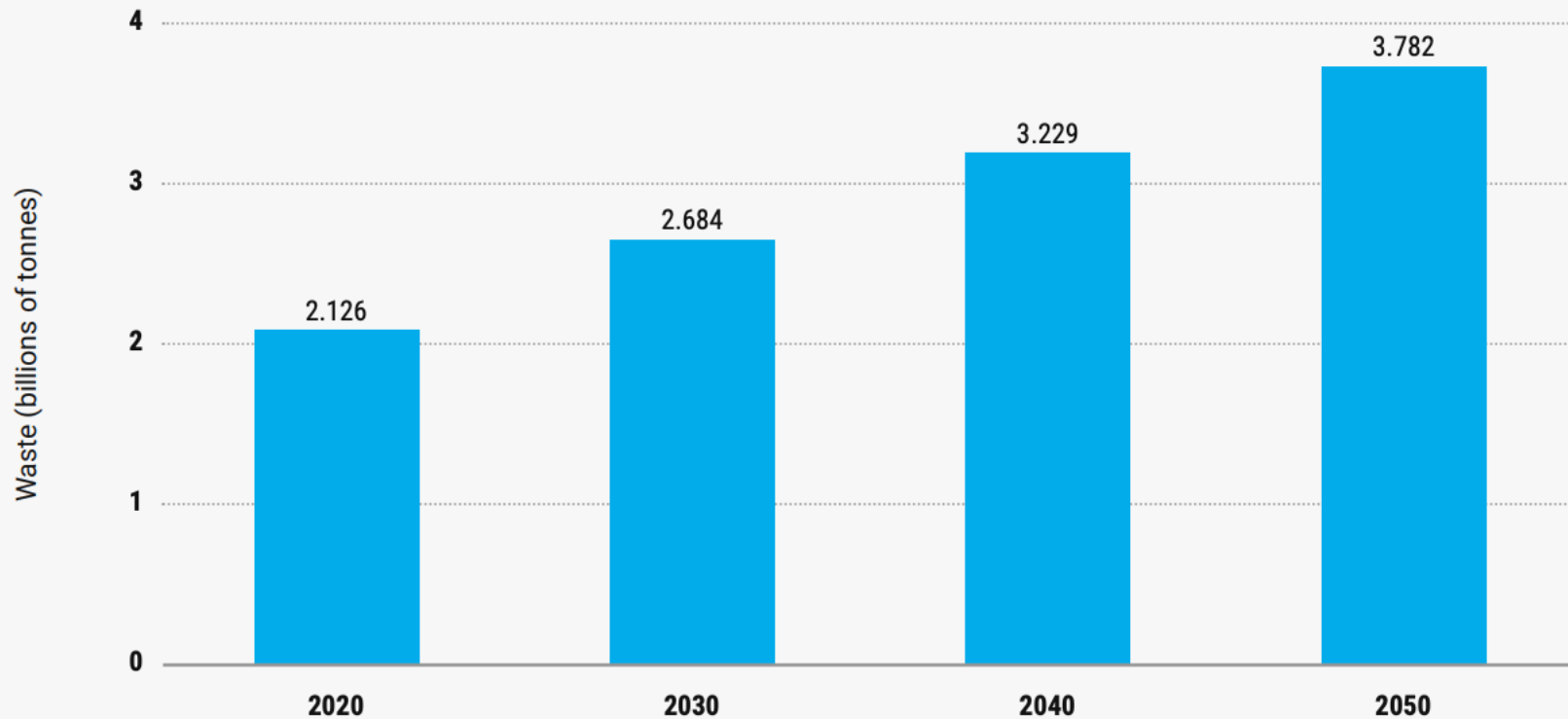
A framework for an integrated waste management system



CURRENT SITUATION

Global Trends

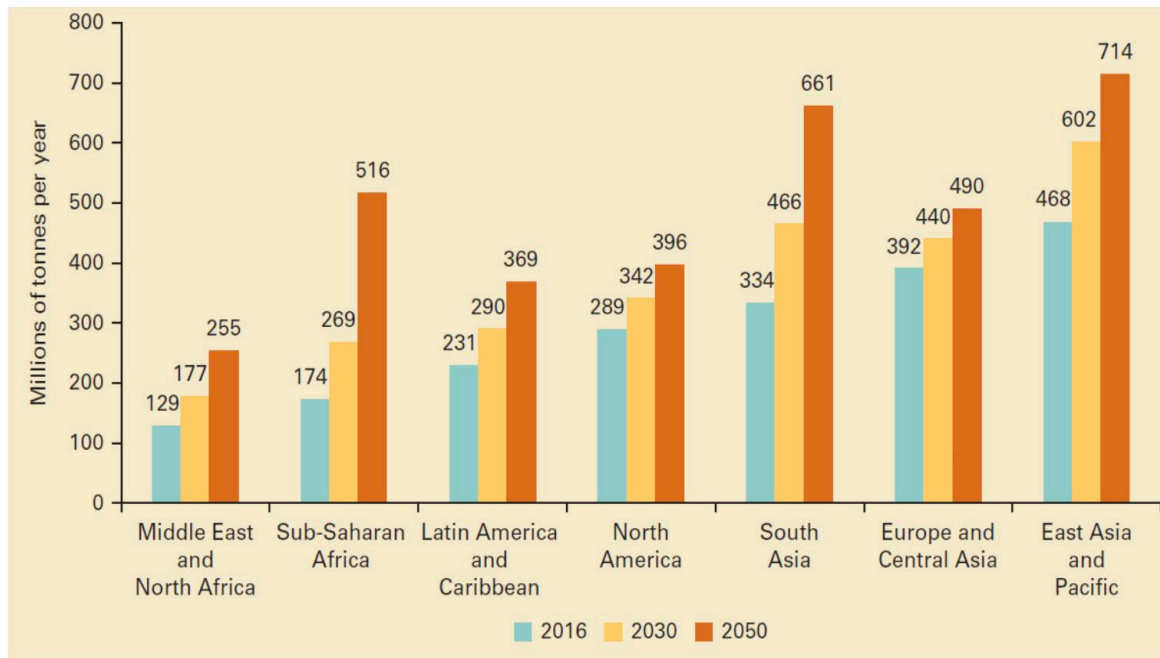
Projections of global municipal solid waste generation per year in 2030, 2040 and 2050 if urgent action is not taken.



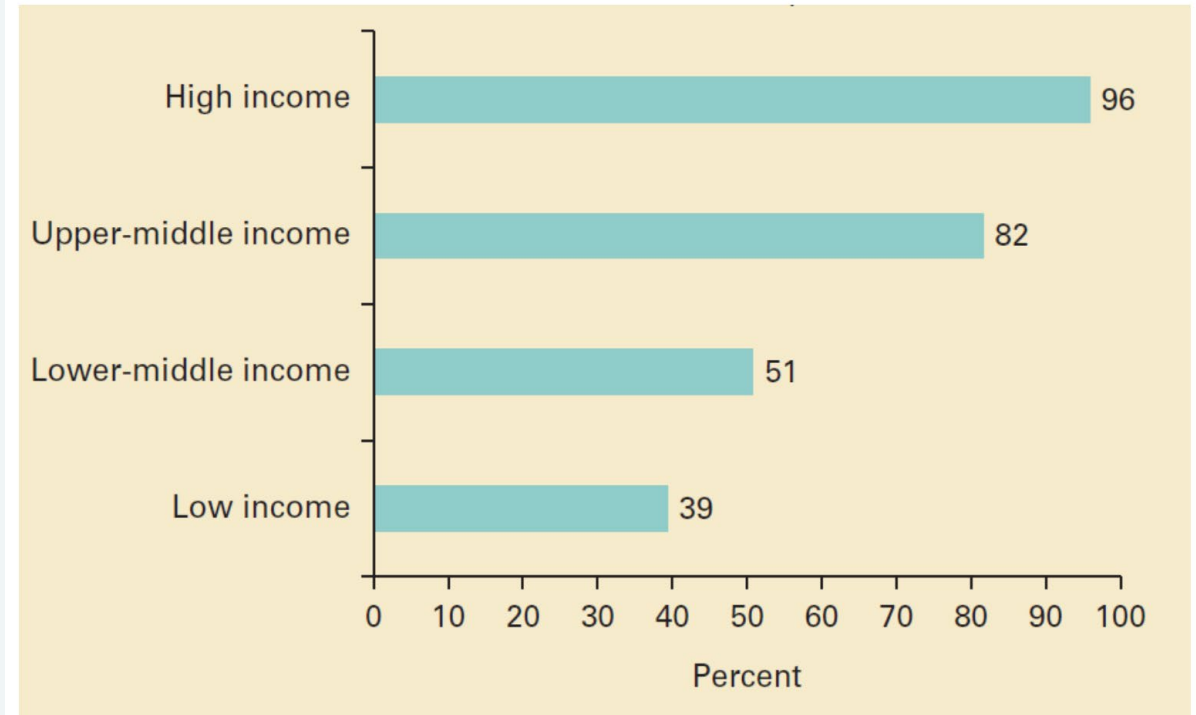
- In 2020, global MSW generation is estimated to have been **2.1 billion** tonnes per year.
- Owing to a combination of economic and population growth, it is projected to increase by 56% to **3.8 billion** tonnes by 2050 *if urgent action is not taken.*

Global Trends

Projected waste generation, by region (millions of tonnes/year)

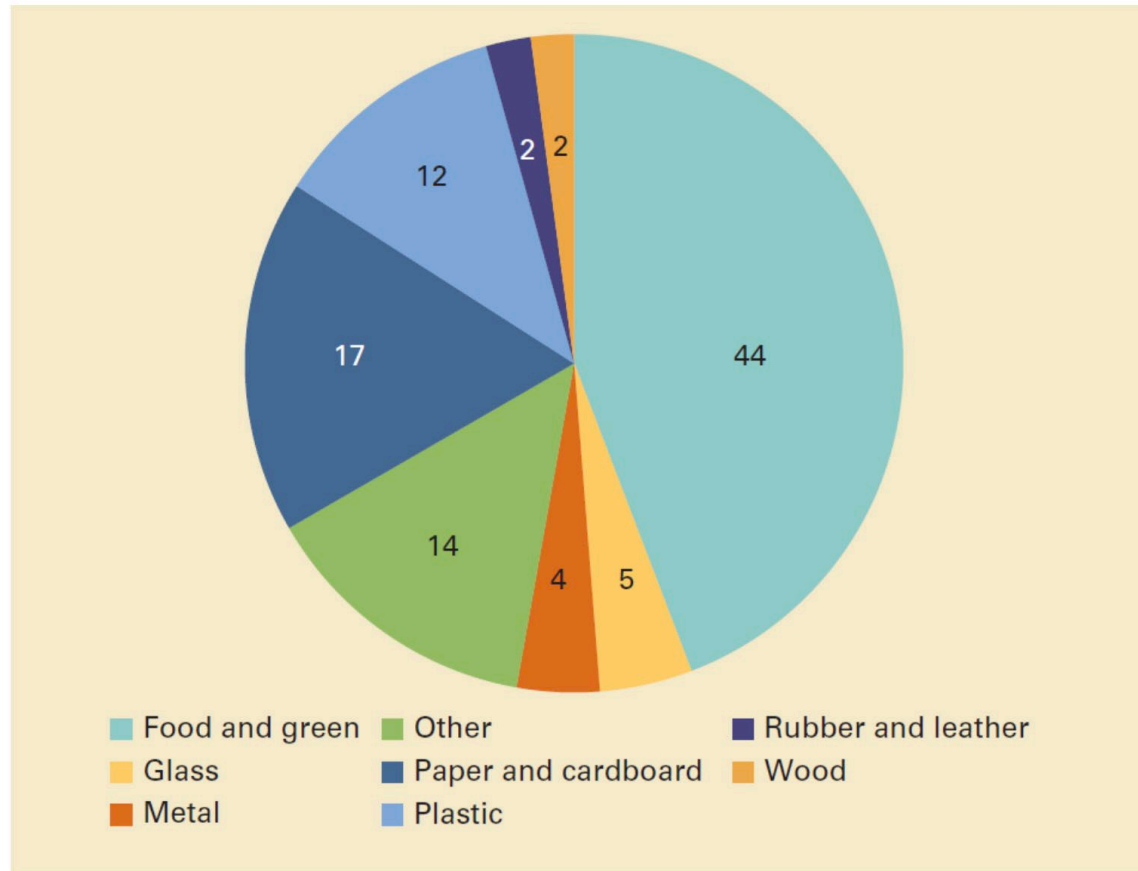


Waste collection rates, by income level (percent)



Global Trends

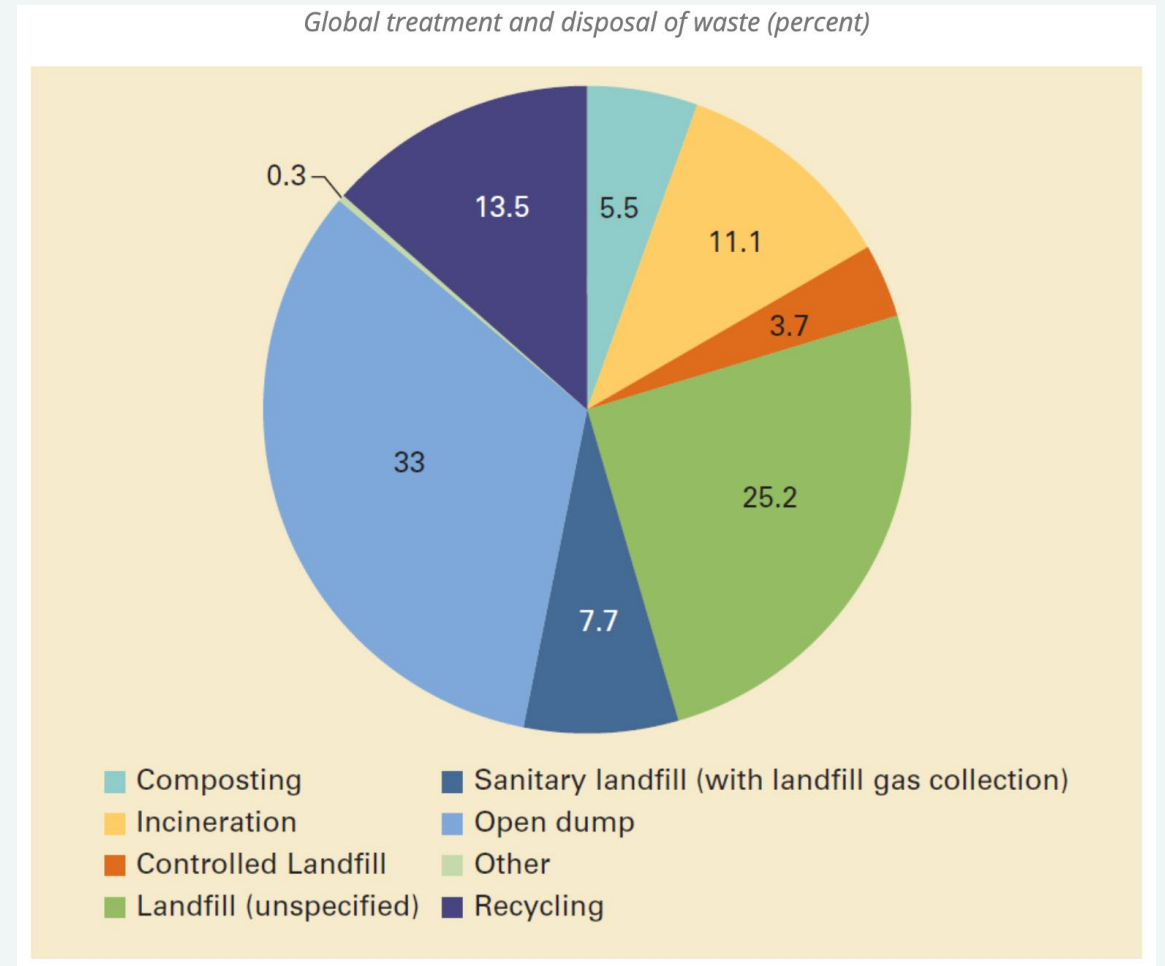
Global waste composition (percent)



- High-income countries generate relatively less food and green waste, at 32% of total waste, and generate more dry waste that could be recycled,, which account for 51% of waste.
- Middle- and low-income countries generate 53% and 57% food and green waste, respectively, with the fraction of organic waste increasing as economic development levels decrease.
- In low-income countries, materials that could be recycled account for only 20% of the waste stream.

Global Trends

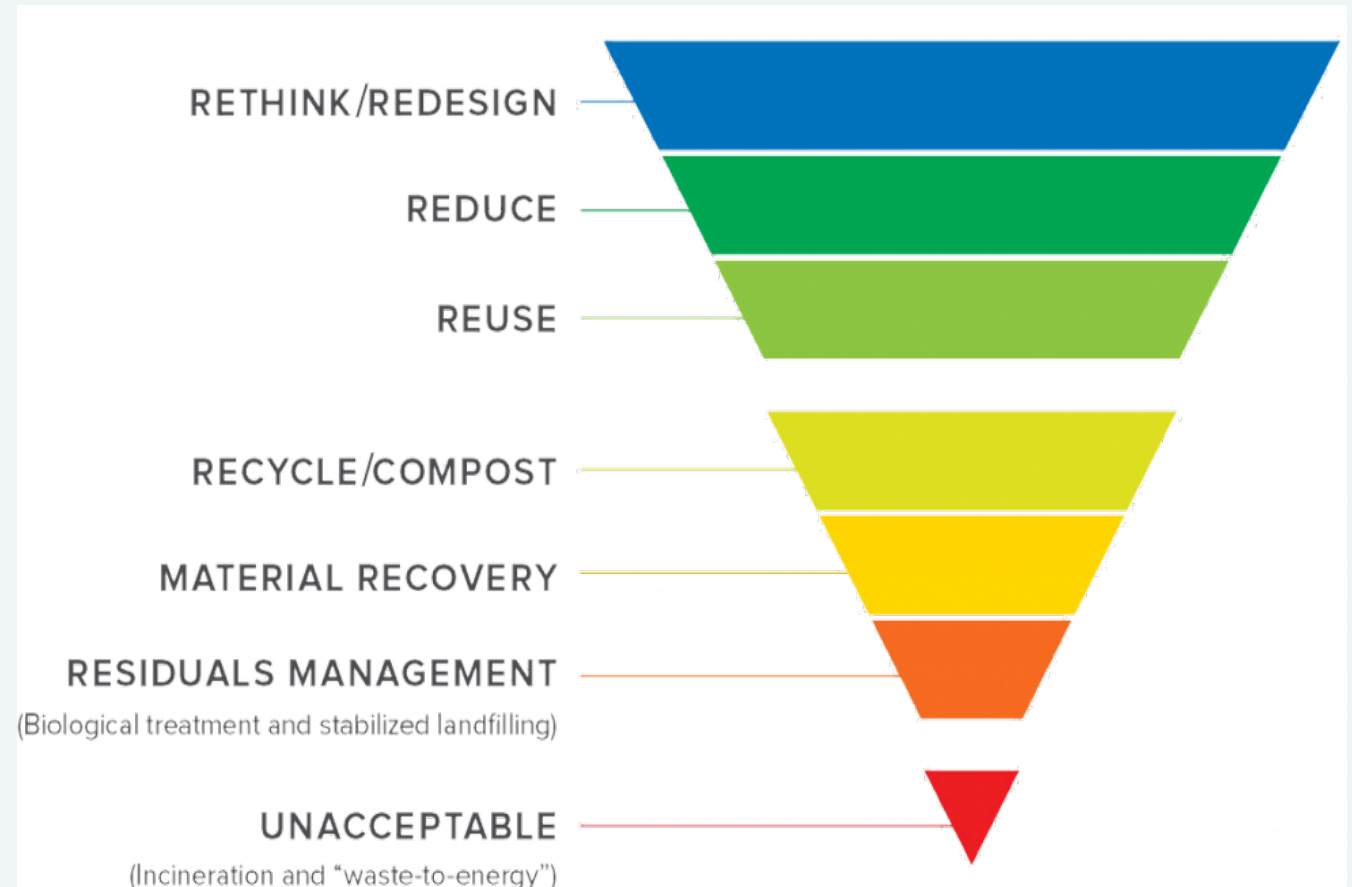
- Lower-income countries generally rely on open dumping; 93% of waste is dumped in low-income countries and only 2% in high-income countries.
- Upper-middle-income countries have the highest percentage of waste in landfills, at 54%.
- This rate decreases in high-income countries to 39%, with diversion of 36% of waste to recycling and composting and 22% to incineration.
- Incineration is used primarily in high-capacity, high-income, and land-constrained countries.



Global Trends

Zero Waste Concept

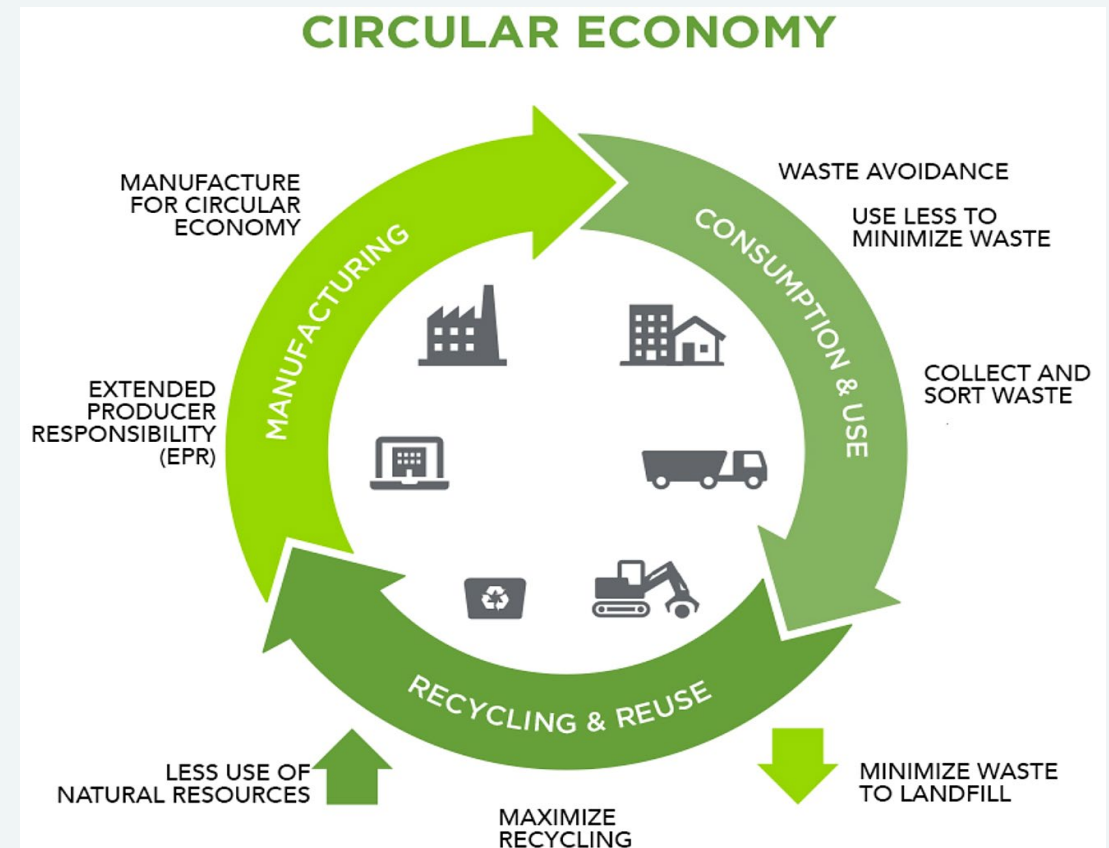
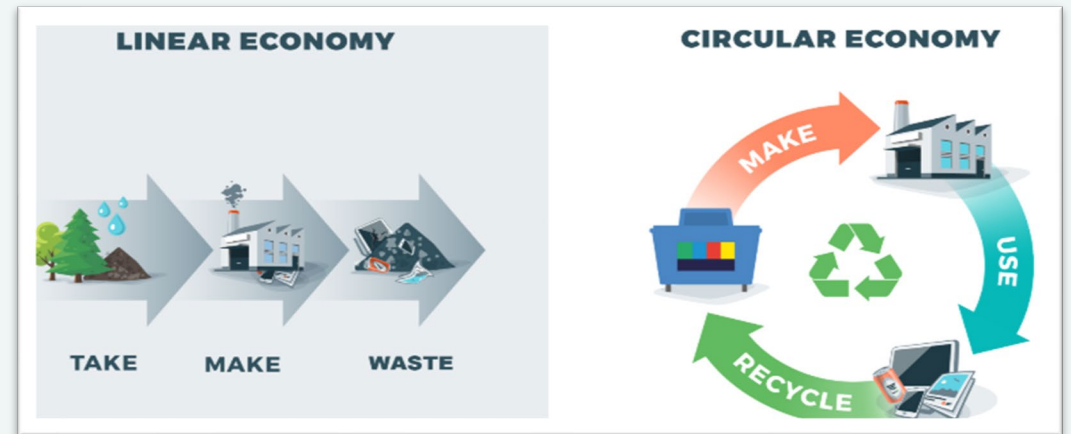
The conservation of all resources by means of **responsible production, consumption, reuse, and recovery** of products, packaging, and materials **without burning and with no discharges** to land, water, or air that threaten the environment or human health (ZWIA, 2018).



Global Trends

Circular economy

- The circular economy is a model of production and consumption, which involves *sharing, leasing, reusing, repairing, refurbishing and recycling* existing materials and products as long as possible.
- In this way, the **life cycle of products is extended**.



FEATURED APPLICATIONS

Countries with High Recycling Rates and Featured Applications

Germany

A recycling program under the brand “Green Dot” is implemented to collect packaging waste from homes and businesses and is financed by the industry on the producer pays principle.

Dry recyclables and biowaste are collected separately.

There are legal regulations restricting single-use disposable products.



Countries with High Recycling Rates and Featured Applications

Austria

Forbidden to store materials with carbon emissions above 5%.

A recycling program that operates under the responsibility of producer is implemented.

Source separation is included in the education curriculum..

The use, trade and import of plastic bags is prohibited.



Countries with High Recycling Rates and Featured Applications

South Korea

- A system is implemented in which recycling companies collect waste and sell it for profit, and financial aid is provided to recycling companies by the state.
- Import of plastic and paper is prohibited.
- Policies are being implemented to ban colored plastic bottles and PVC.
- Plastic waste is collected separately from other recyclable waste.



Countries with High Recycling Rates and Featured Applications

Wales

- There are legal regulations restricting disposable products.
- Dry recyclables and biowaste are collected separately.
- Storage or burning bans apply for some materials.



Countries with High Recycling Rates and Featured Applications

Switzerland

A waste collection system is implemented where households and businesses pay for the non-recyclable waste they produce.

Garbage bags used for storage are taxed. .

Recycling points where recyclable waste is collected and reimbursed are widely used in supermarkets across the country.



PROBLEMS ENCOUNTERED IN WASTE MANAGEMENT IN DIFFERENT SECTORS

Problems Encountered in Waste Management

- Improper waste management and illegal disposal practices
- Use of inappropriate vehicles for waste collection
- Recycling method disputes
- Lack of social cooperation
- Financial inadequacies



Problems Encountered in Plastic Waste Management



Problems Encountered in Construction Waste Management

Lack of legislation against illegal disposal practices

Prioritizing cost advantage over environmental sustainability

Negative perceptions of the quality of secondary materials

Insufficient efforts to improve recycling and reuse rate

Problems Encountered in E-Waste Management

Lack of:

- recycling infrastructure or proper e-waste management
- effective take-back programs
- legislation to control the flow (import) of e-waste from developed countries to developing countries
- awareness among consumers
- awareness among collectors and recyclers about the potential dangers
- recycling facilities to maximize the economic benefits of e-waste





Thank you for listening



Prof. Dr. Turgut T. ONAY

onayturg@bogazici.edu.tr