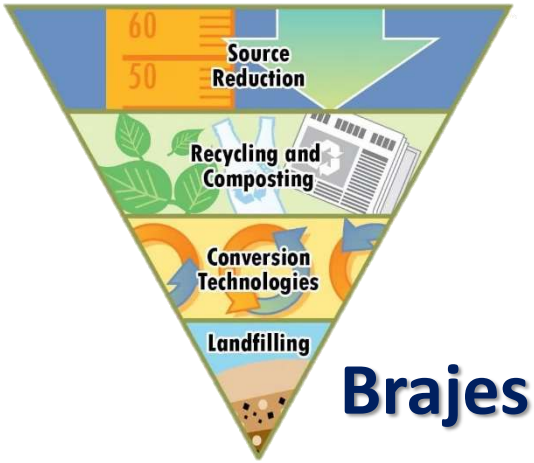
ENVIRONMENTAL SCIENCE

EV10003

Waste management



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Topics covered

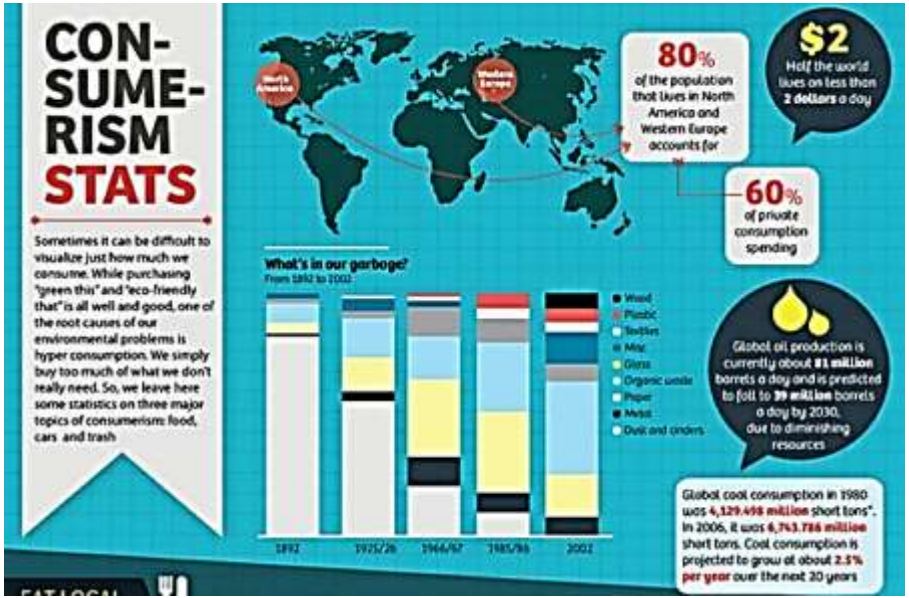
- Consumerism and our throw-away culture
- Characteristics of municipal solid waste
- Sustainable practices in waste management
- CPHEEO guidelines for solid waste management
- Transition to zero waste lifestyle
- Tackling the rise of e-waste
- Looming waste crisis from global renewable energy boom

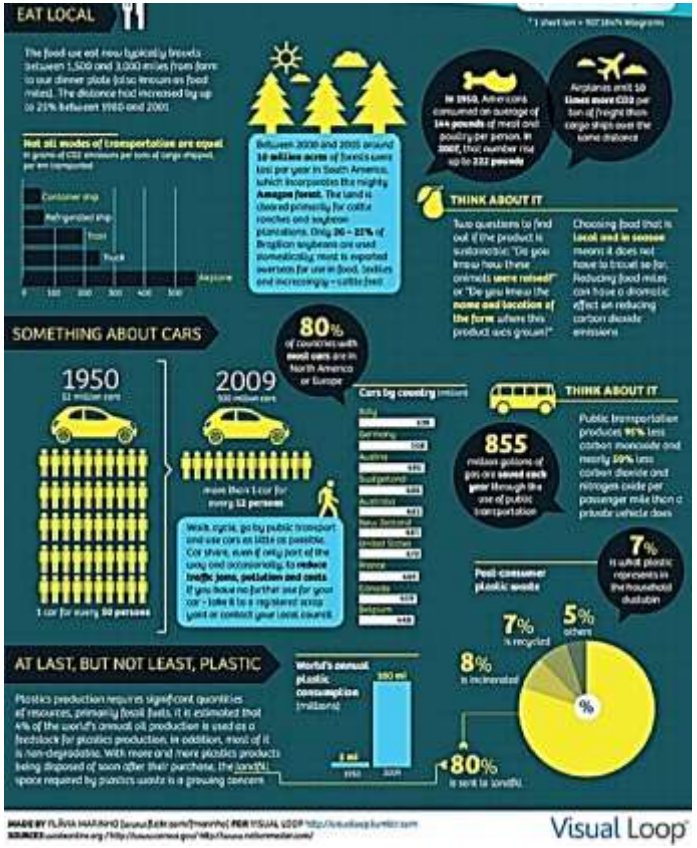
Consumerism and our throw-away culture

- ***Consumerism*** is related to the constant purchasing of ***new goods***, with little attention to their true need, ***durability, product*** origin, or the environmental consequences of their manufacture and ***disposal***.
- Most human activities are related to ***production and consumption cycle*** which produce ***excessive amounts of waste*** in the form of solid, liquid and gaseous waste products.

https://www.canadiangeographic.ca/article/canadas-dirty-secret

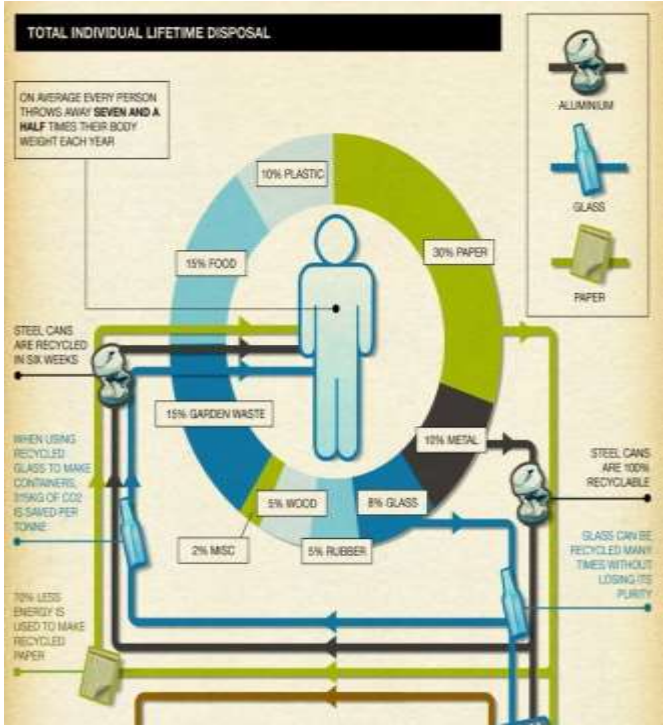
Consumerism and our throw-away culture

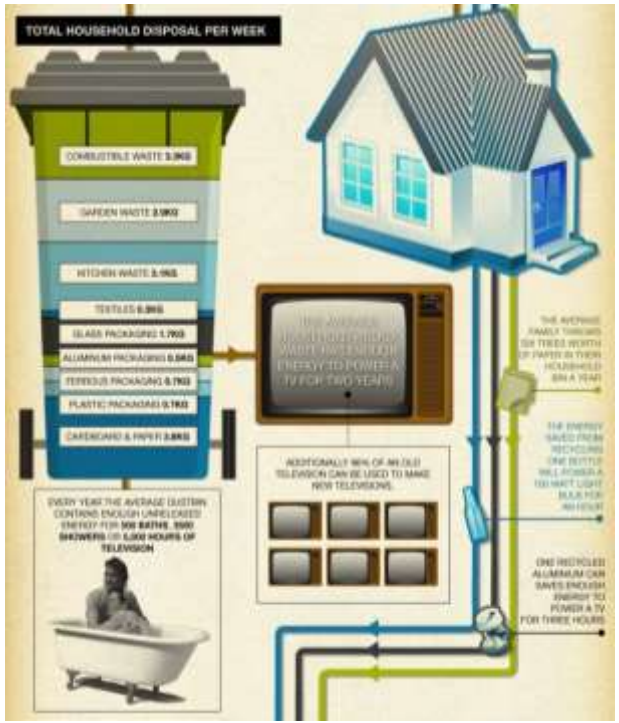


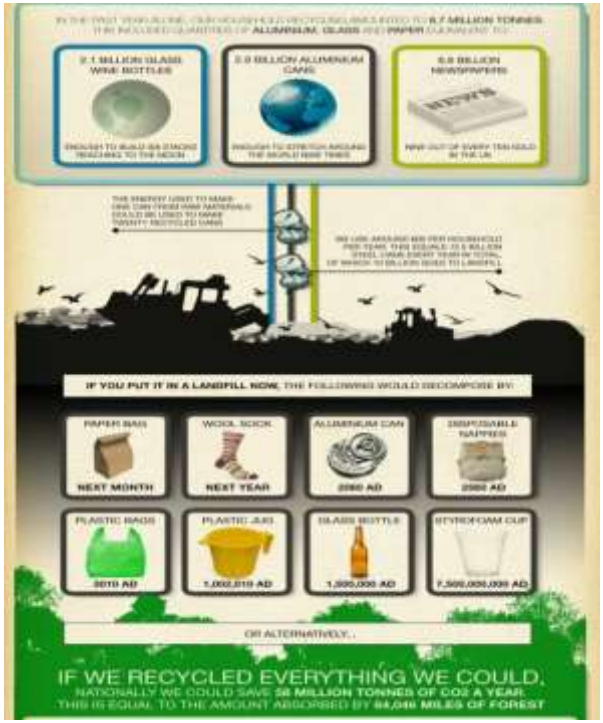


https://in.pinterest.com/pin/102316222762788896/

Consumerism and our throw-away culture







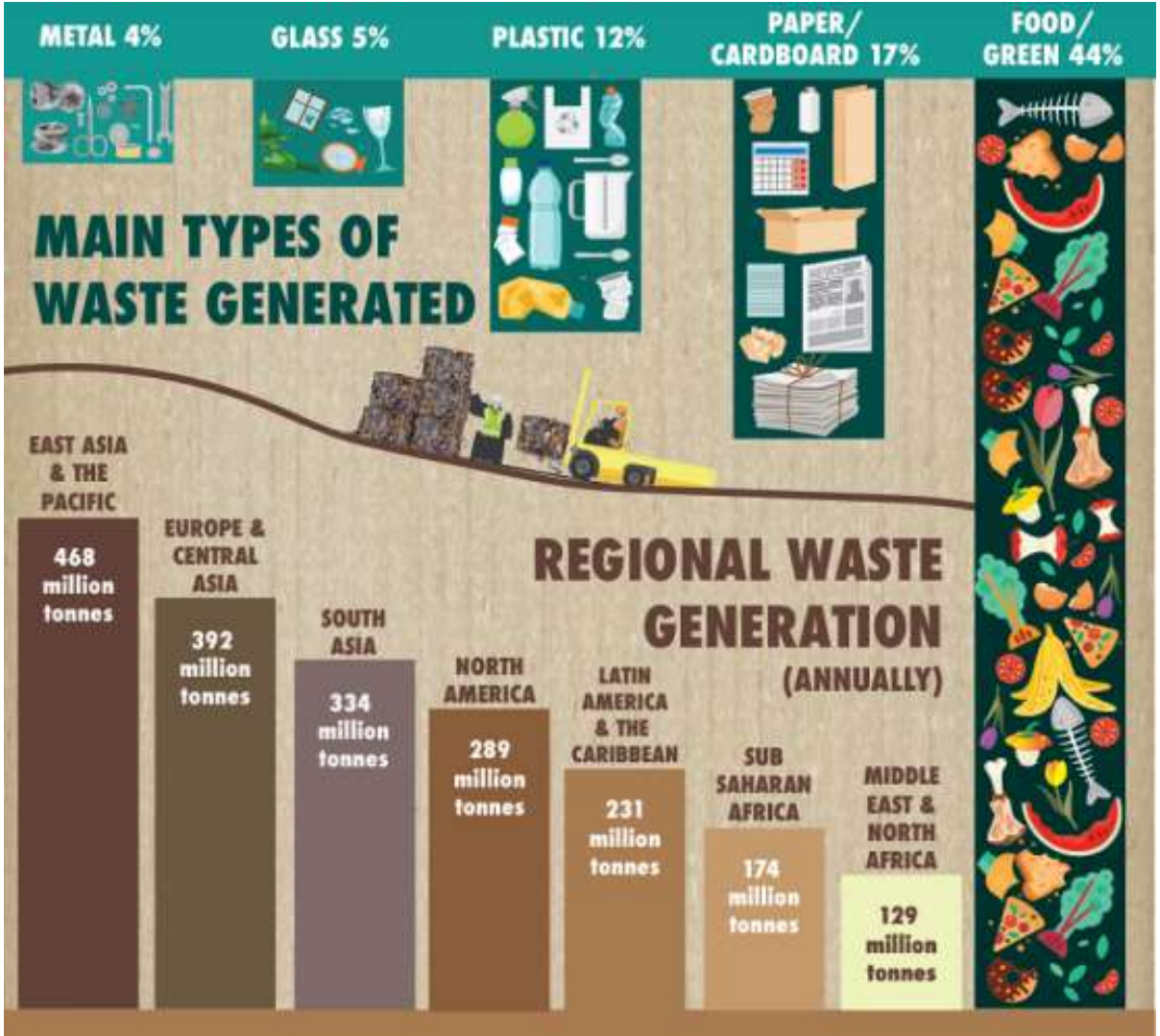
https://expressrecyclingandsanitation.com/2013/07/15/we-are-a-throw-away-culture-infographic/

WHAT A WASTE 2.0

A Global Snapshot of Solid Waste Management to 2050

The world generates **2.01 BILLION TONNES** of municipal solid waste annually.

Unless urgent action is taken, global waste will increase 70% to **3.4 BILLION TONNES** by 2050!


METAL 4%
GLASS 5%
PLASTIC 12%
PAPER/ CARDBOARD 17%
FOOD/ GREEN 44%
MAIN TYPES OF WASTE GENERATED
REGIONAL WASTE GENERATION (ANNUALLY)
EAST ASIA & THE PACIFIC
468 million tonnes
EUROPE & CENTRAL ASIA
392 million tonnes
SOUTH ASIA
334 million tonnes
NORTH AMERICA
289 million tonnes
LATIN AMERICA & THE CARIBBEAN
231 million tonnes
SUB SAHARAN AFRICA
174 million tonnes
MIDDLE EAST & NORTH AFRICA
129 million tonnes

For effective waste disposal, segregation is the key

BY ET CONTRIBUTORS | JAN 13, 2018, 11.30 PM IST

Post a Comment

By Brajesh Dubey

Segregation is one of the most important activities that we need to promote and enforce for effective waste management in urban area and to make landfills reduce in size gradually and finally come to no landfills in four-five decades from now. Even in Western Europe where they have been working on developing a scientific waste management systems for the last 30 years or so, nearly one-third of waste is still going to the engineered landfill. In India, too, we cannot have "zero" landfill or "no" landfill overnight. This is not a realistic expectation.

Segregation of waste components should be encouraged at source, the new MSW rules 2016 do that.

We don't have the technology to recycle and/or treat all the waste that we produce. Therefore, for the waste that cannot be recycled or treated, we do need a resting place, and that is usually an engineered landfill in developed countries. Even 100% residual from waste incinerators cannot be reused, only few countries are using the ash from waste-to-energy plants and even in those cases they have to discard some of the ashes in landfills.

Segregation of waste components should be encouraged at source, the new MSW rules 2016 do that. What we need is to build capacity at the municipal level to enforce and implement source segregation. If you and I do source segregation at our homes but they get mixed up in the collection vehicle along the route to treatment plant, there is no point of doing source segregation. Also, educating people to do source segregation at home takes time. For now, if needed, we should also look at the options of doing segregation at a central facility. The use of any proper treatment technology requires separated waste. For treatment technologies, waste needs to be clean enough for effective treatment.

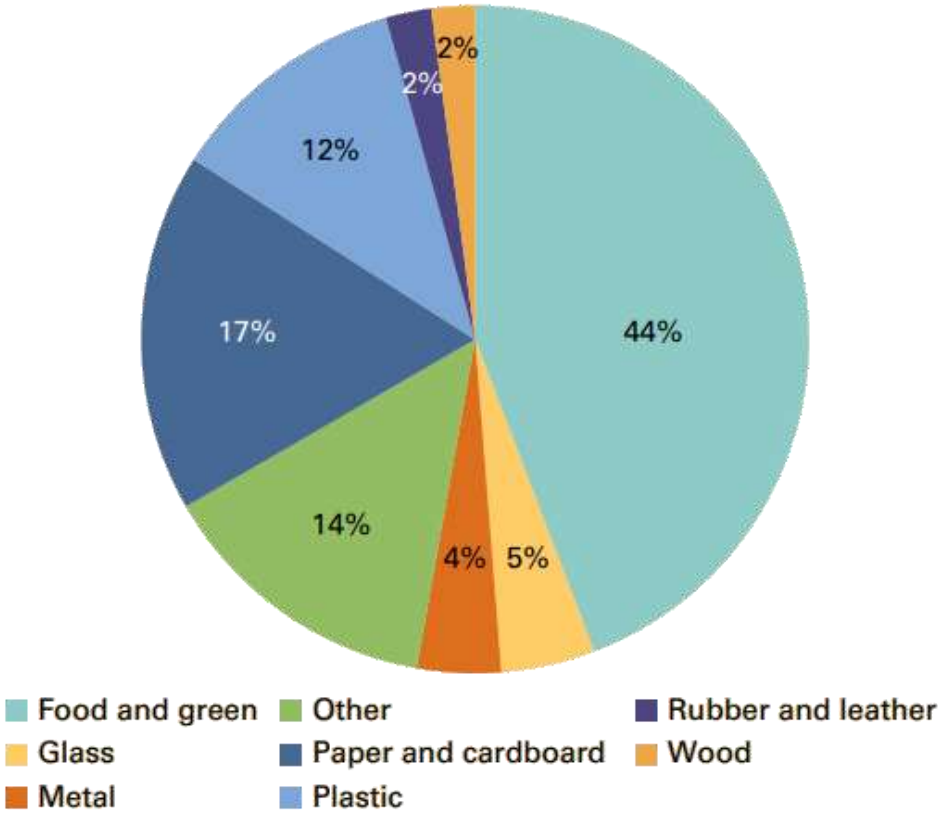
Related

- How to make Waste-to-Wealth a reality

Big Change:
The end of Five-Year Plans: All you need to know

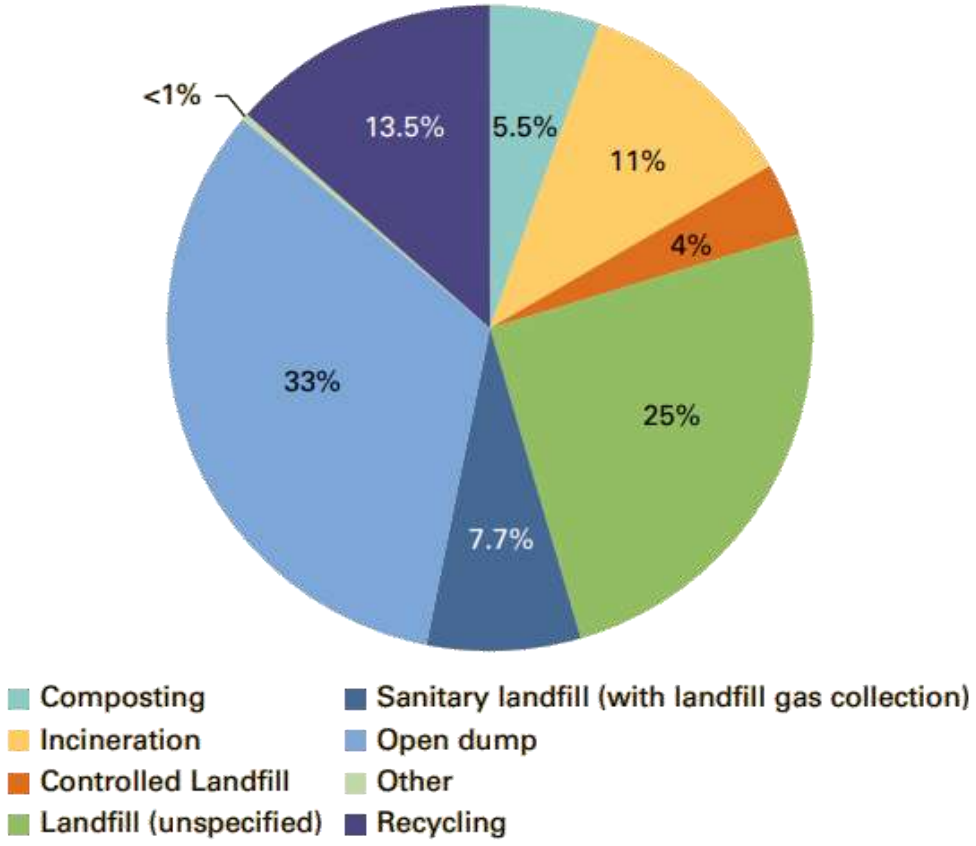
https://science.howstuffworks.com/environmental/conservation/issues/deadly-1948-donora-smog-launched-clean-air-movement.htm

Global waste composition



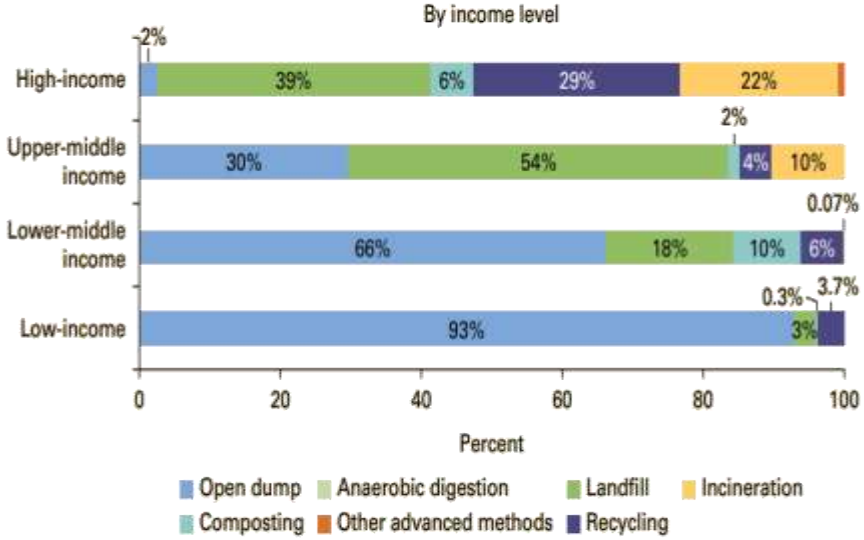
Source: What a waste 2.0

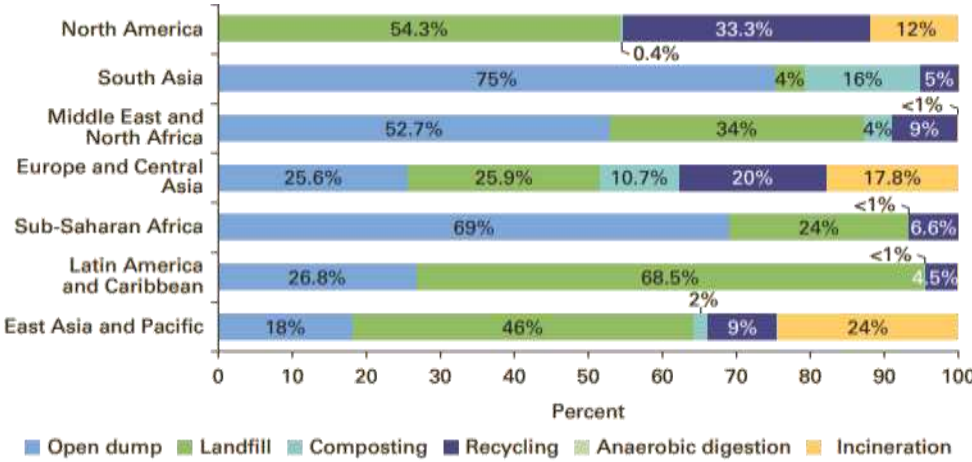
Global waste treatment & disposal



Source: What a waste 2.0

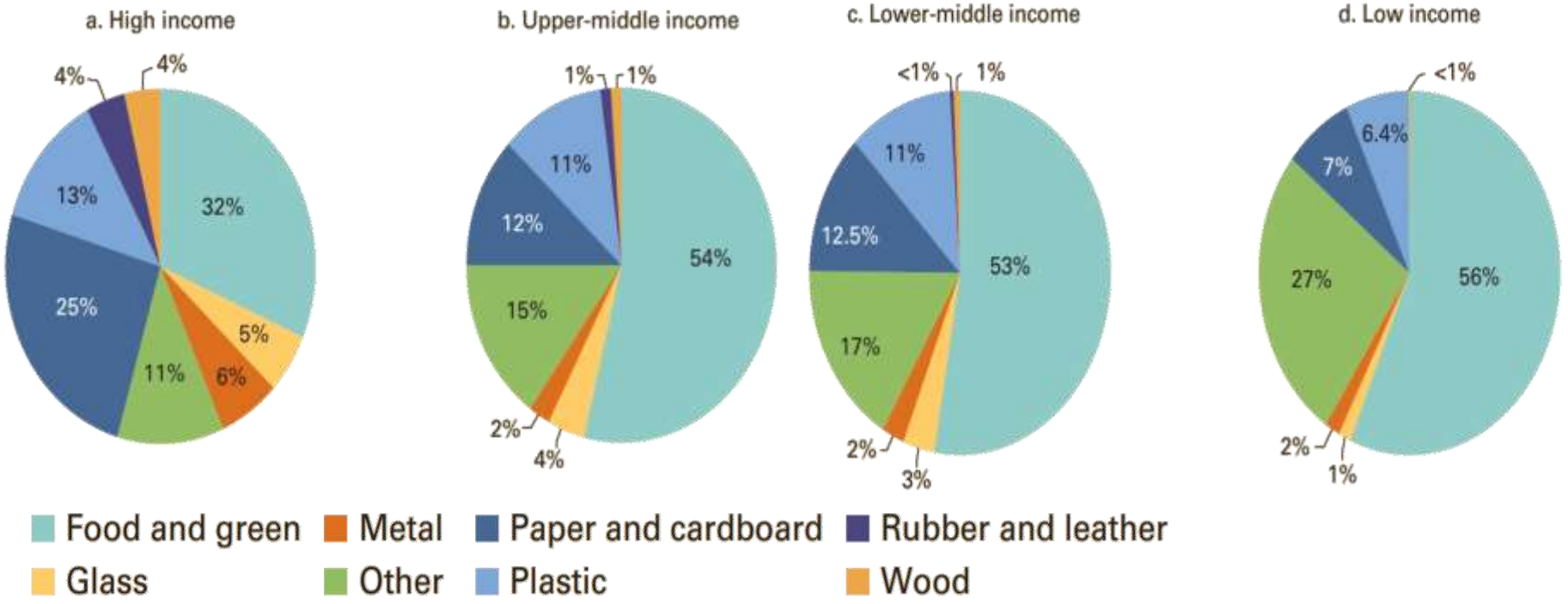
Global waste disposal by income & region





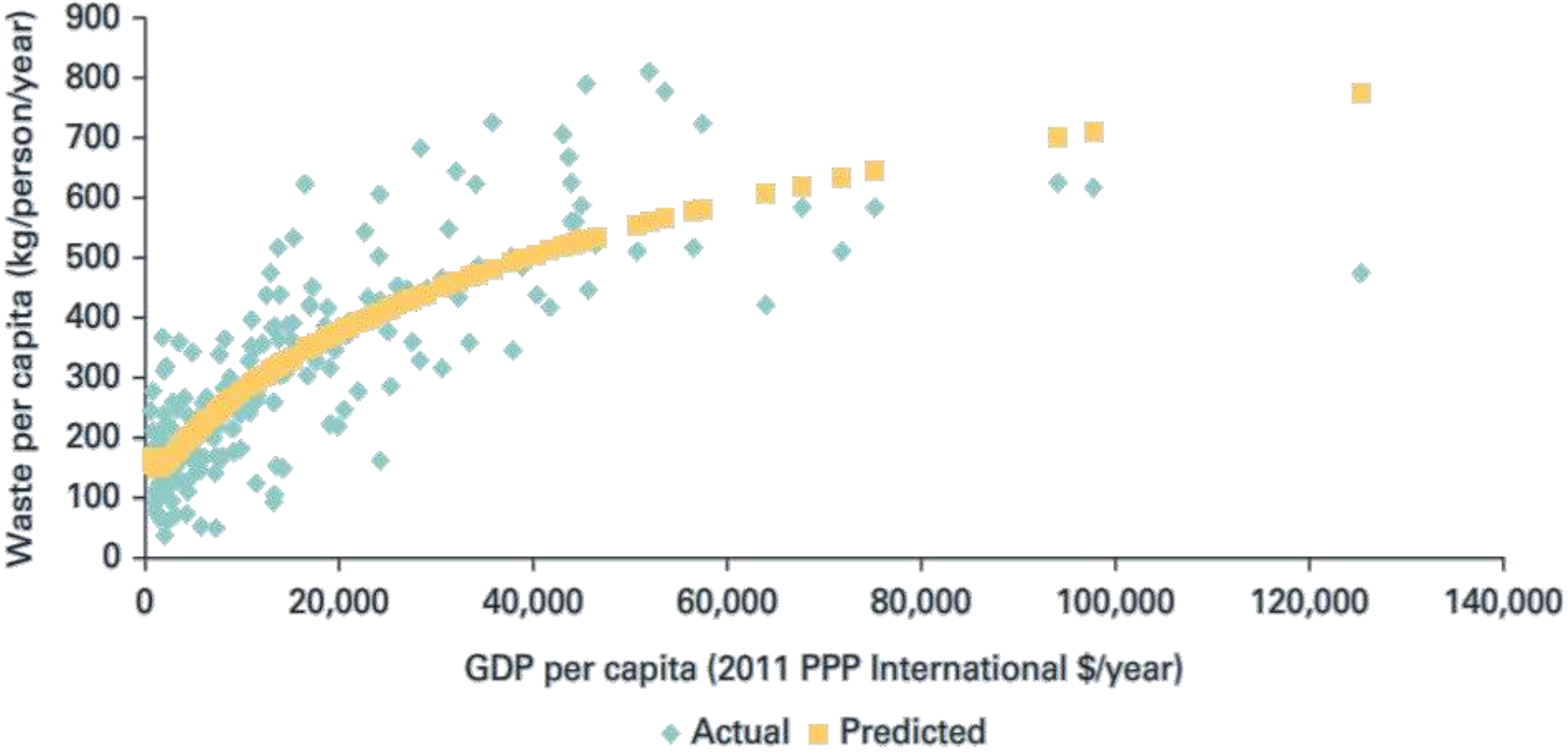
Source: What a waste 2.0

Global waste composition by income level



Source: What a waste 2.0

Relationship b/w GDP growth & waste generation

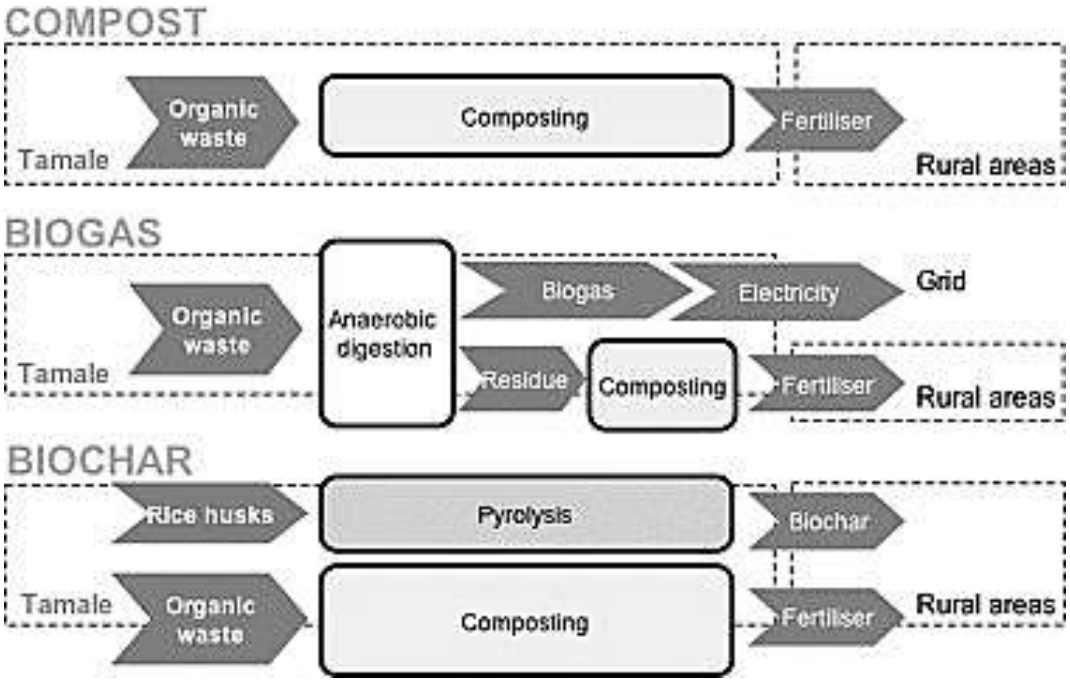


Source: What a waste 2.0

Waste segregation

Source: https://depositphotos.com/vector-images/bin.html

Organic waste management



Source: https://ars.els-cdn.com/content/image/1-s2.0-S0956053X14003328-gr1.jpg

Plastic waste management

- Mechanical recycling
  - Palletizing
  - Extrusion
  - Injectiom molding
  - Drawing
  - Shredding
- Feedstock recycling
  - Pyrolysis
  - Gasification
  - Waste to fuel
- Energy recovery
  - Incineration
  - Coincineration
- Landfill

Source: https://www.sciencedirect.com/science/article/pii/B9780128131404000121?via%3Dihub

Electronic waste management

Source: http://www.omrsolutions.com/omr_web/solutions/government/e-waste-management.php

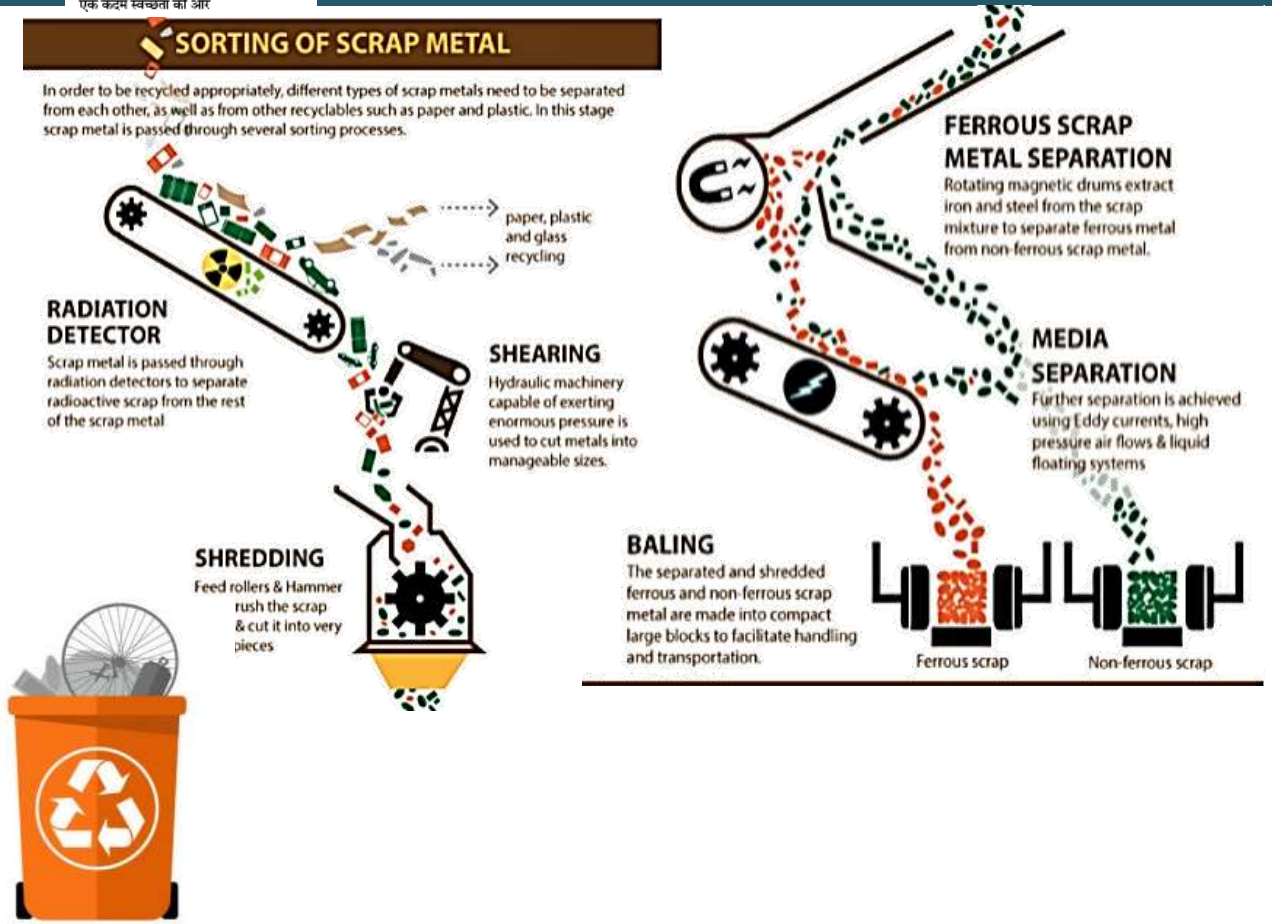
Paper waste management

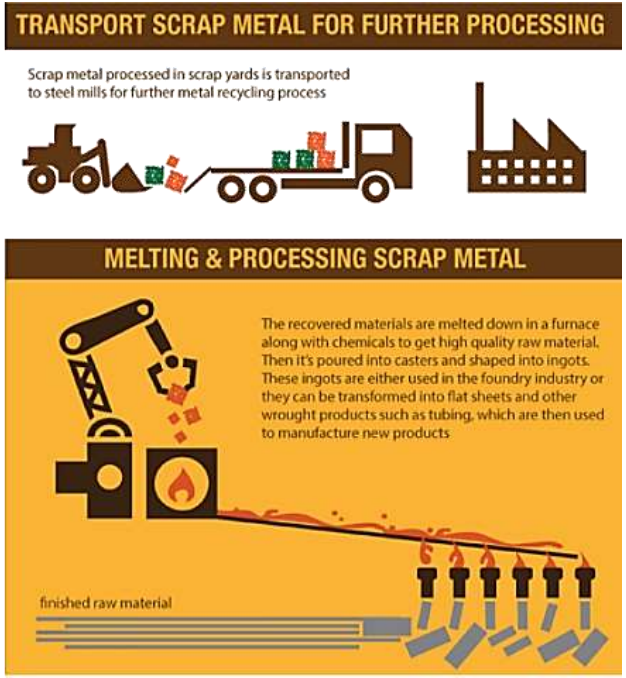
Source: https://www.dreamstime.com/illustrative-diagram-paper-waste-recycling-process-illustrative-diagram-paper-waste-recycling-process-step-step-image200556145

Glass waste management

Source: https://www.shutterstock.com/nl/image-vector/infographic-diagram-glass-waste-recycling-process-1507470893

Metal waste management





Source: https://visual.ly/community/Infographics/environment/metal-recycling-process

Inert waste management

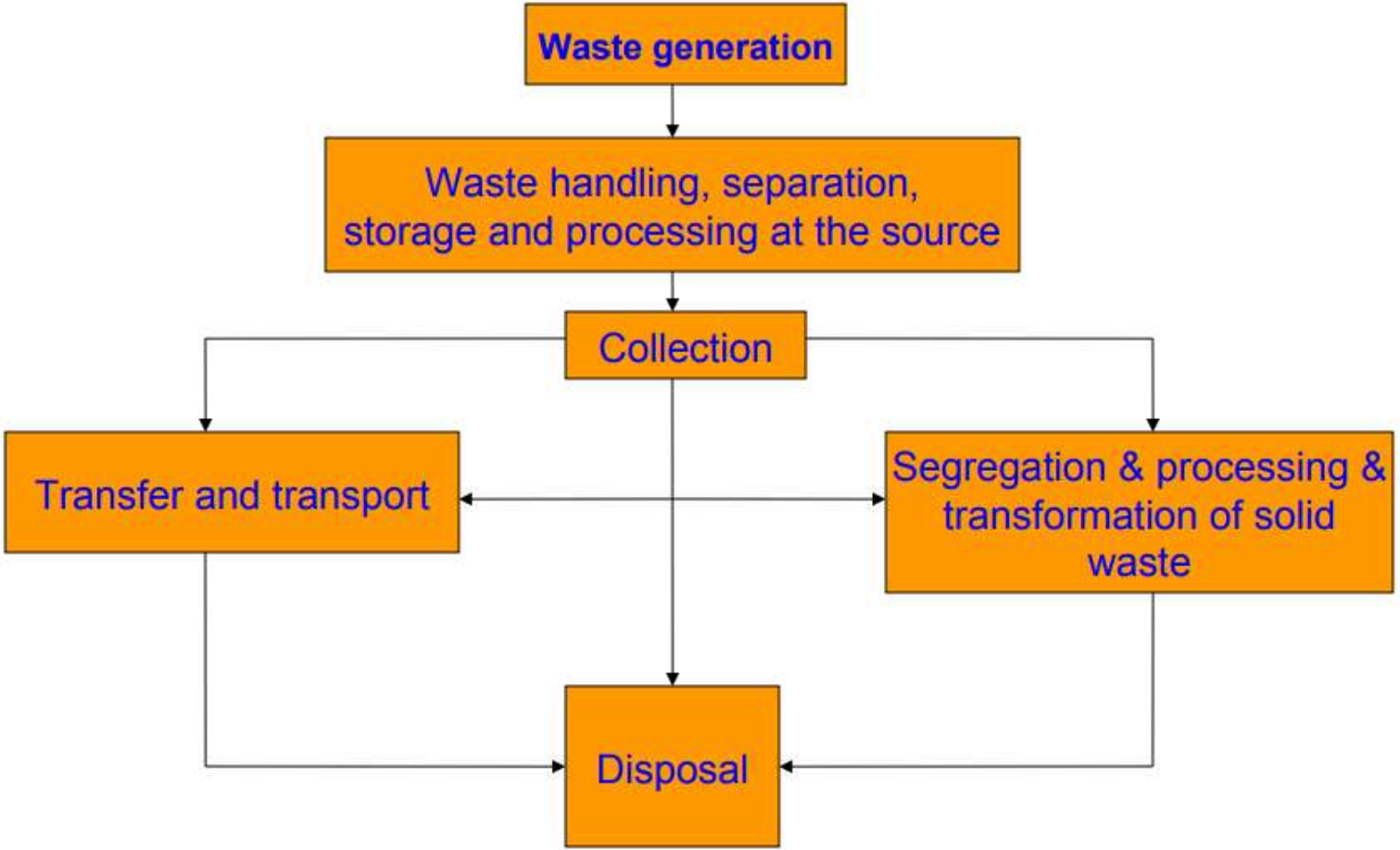
- Inert waste is generally sent to a sanitary landfill
- It can be used in construction as a substituent material
- However, only non-hazardous waste can be used in construction

Source: https://www.kissclipart.com/free/landfill,2.html

6 elements of a waste management system

1. Waste Generation
2. Handling separation storage and processing at source
3. Collection
4. Separation processing and transformation
5. Transfer and transport
6. Disposal

Functional elements of waste management system



Waste Generation

- Waste is material that has no further value to its owner and is thrown away
- Some has further value to others (reuse)
  - Chemical ingredients
  - Electronic parts
  - Compost for your garden
- Some is just waste (disposal)
  - Food wrappings
  - Product containers
  - Household hazardous
- As technology develops, something that was previously considered as waste may have renewed value:
  - Food to CH_4 for energy production

https://www.123rf.com/clipart-vector/food_waste.html

Handling, separation, storage & processing at source

- Best place is at the source
- Placed in various containers (blue-green-yellow)
- Separate the valuable from the waste (paper, metals, plastics)
- Avoid contamination from hazardous waste
- Proper on-site storage for health reason
- Need the cooperation of citizens for separation for work
  - At home and at work
  - Houses vs. condos vs. apartments
  - Much of it can be contaminated and must be processed at a facility
- Onsite processing can include composting and compaction into various containers

Collection

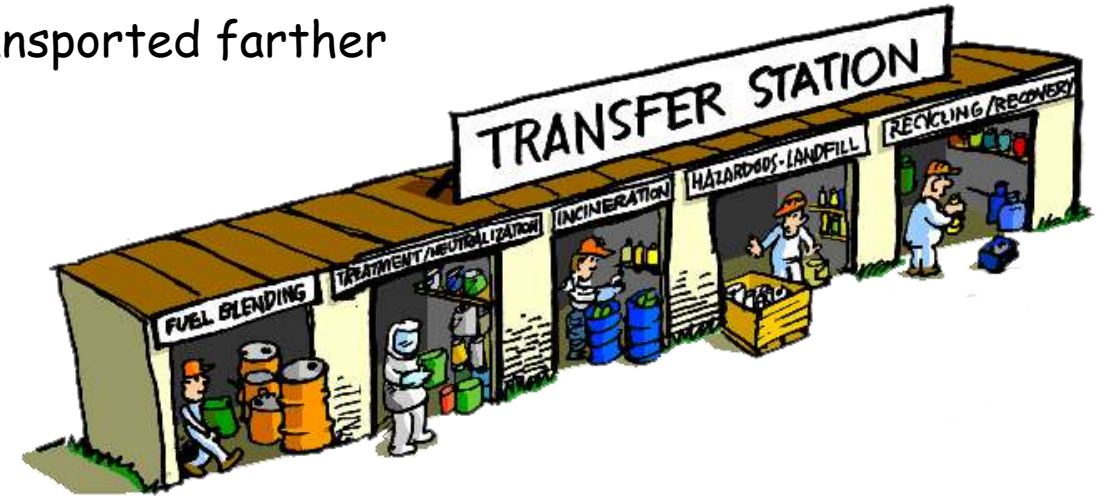
- Gathering waste and recyclables
- Transport to recycle transfer or disposal facilities
- Interim disposal at transfer station
- The location is a function of distance to disposal site
- Considered the most expensive component of solid waste handling
- Industries are handled separately from municipal waste

Separation, processing and transformation

- Could be as simple as opening bags
- Special facilities to separate recyclables into various streams
  - Includes shredding for easier handling
  - Compacting to reduce shipping costs
  - Screens and mechanical separators
- Incineration and composting are considered as transformation of the waste

Transfer and transport

- Smaller collection vehicles used to bring the waste to final destination (landfill incinerator) or to a transfer station
- Compacted further and transported farther
  - Truck
  - Rail (cheapest)
  - barge

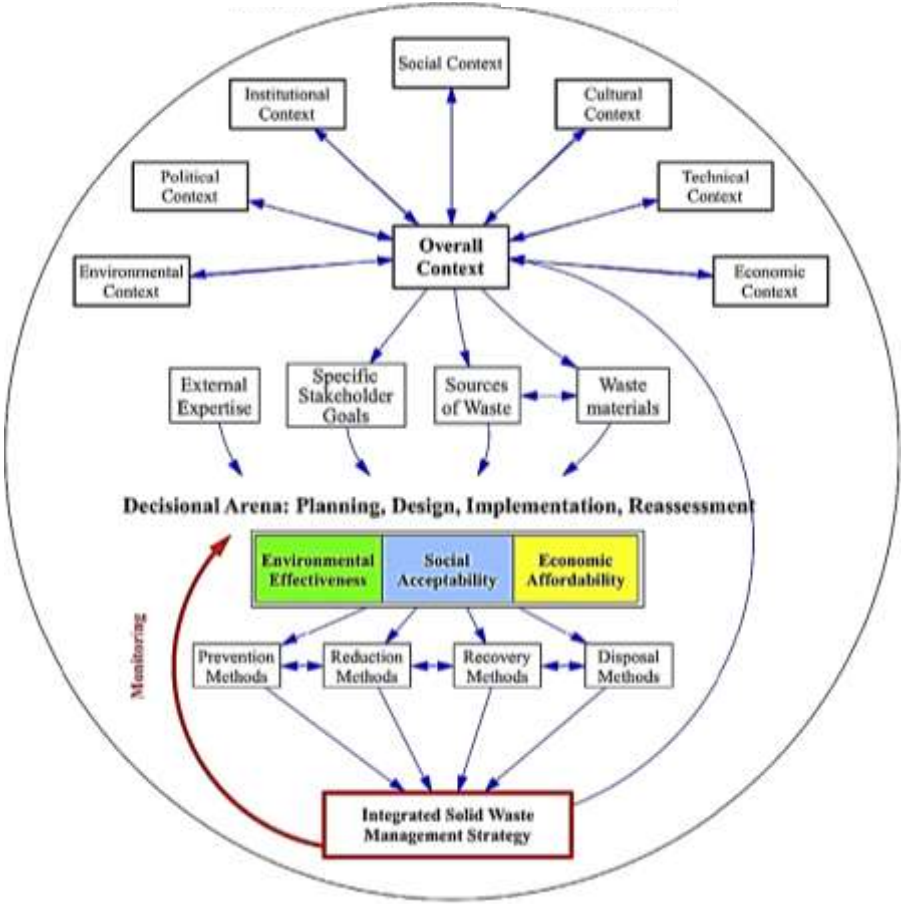


https://www.hudsonnh.gov/publicworks/page/transfer-station-guide

Disposal

- Landfill of waste or the residue of processed/transferred waste
- Considered the final destination with large liability
- A modern landfill is an engineered facility to safely contain waste
- Provides for maximum CH_4 production and minimal escape of leachate
  - The quicker the CH_4 is produced the faster the landfill is stabilized allowing the site to be "reused"
- Incinerated waste would have different characteristics

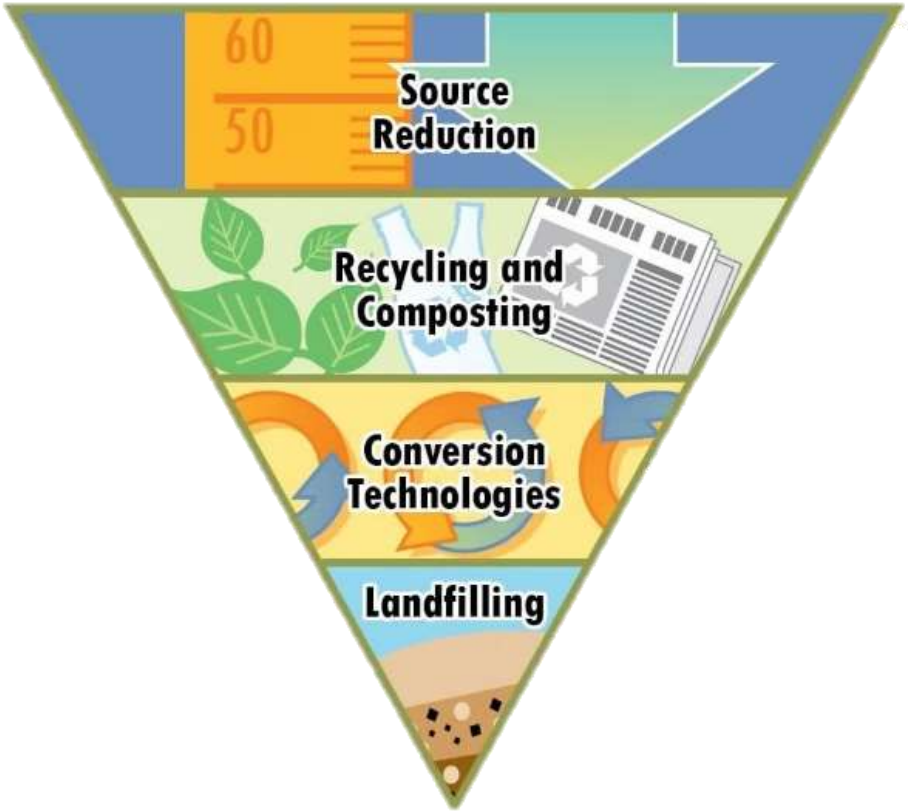
Solid waste management paradigm

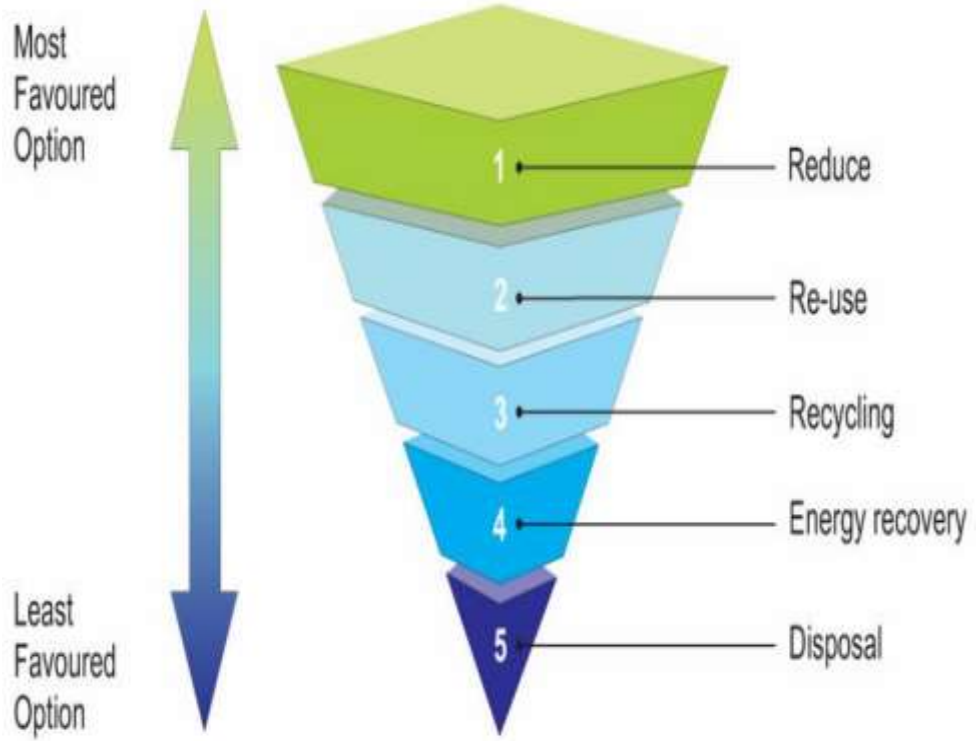


- Political science
- Geography
- Economics
- Public health
- Sociology
- Communications
- Material science
- Archeology
- Engineering ← Its just a small component

https://www.semanticscholar.org/paper/Systems-approaches-to-integrated-solid-waste-in-Marshall-Farahbakhsh/cb04c5513799df1b589cd24d76b358730c97b436

Integrated Solid waste management





https://wasteadvantagemag.com/evolution-of-integrated-solid-waste-management-systems-enhanced-with-municipal-utilities-and-green-energy-production/

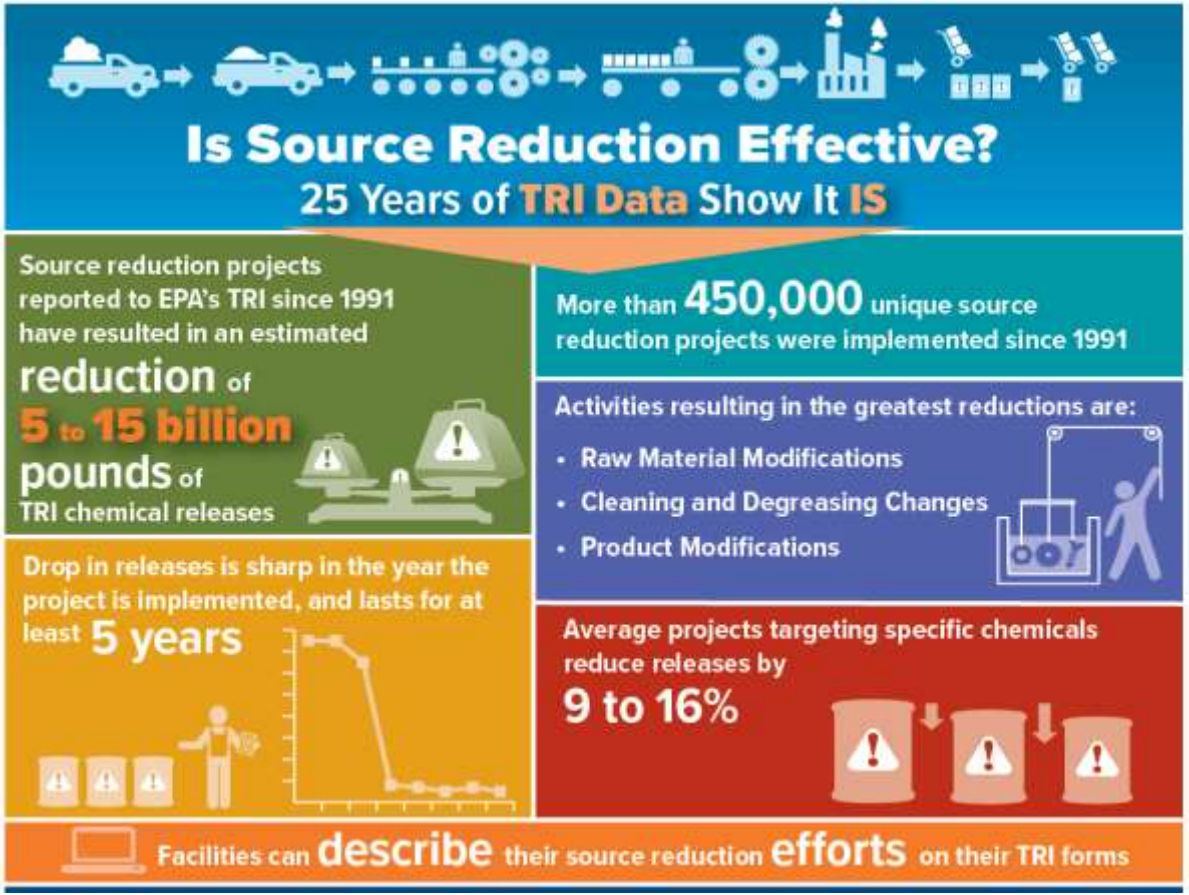
Source reduction

- Reduce material use in product manufacture
- Increase useful life through durability and reparability
- Decrease toxicity
- Material reuse (pallets, containers, etc.)
- Efficient consumer use of materials

Source reduction

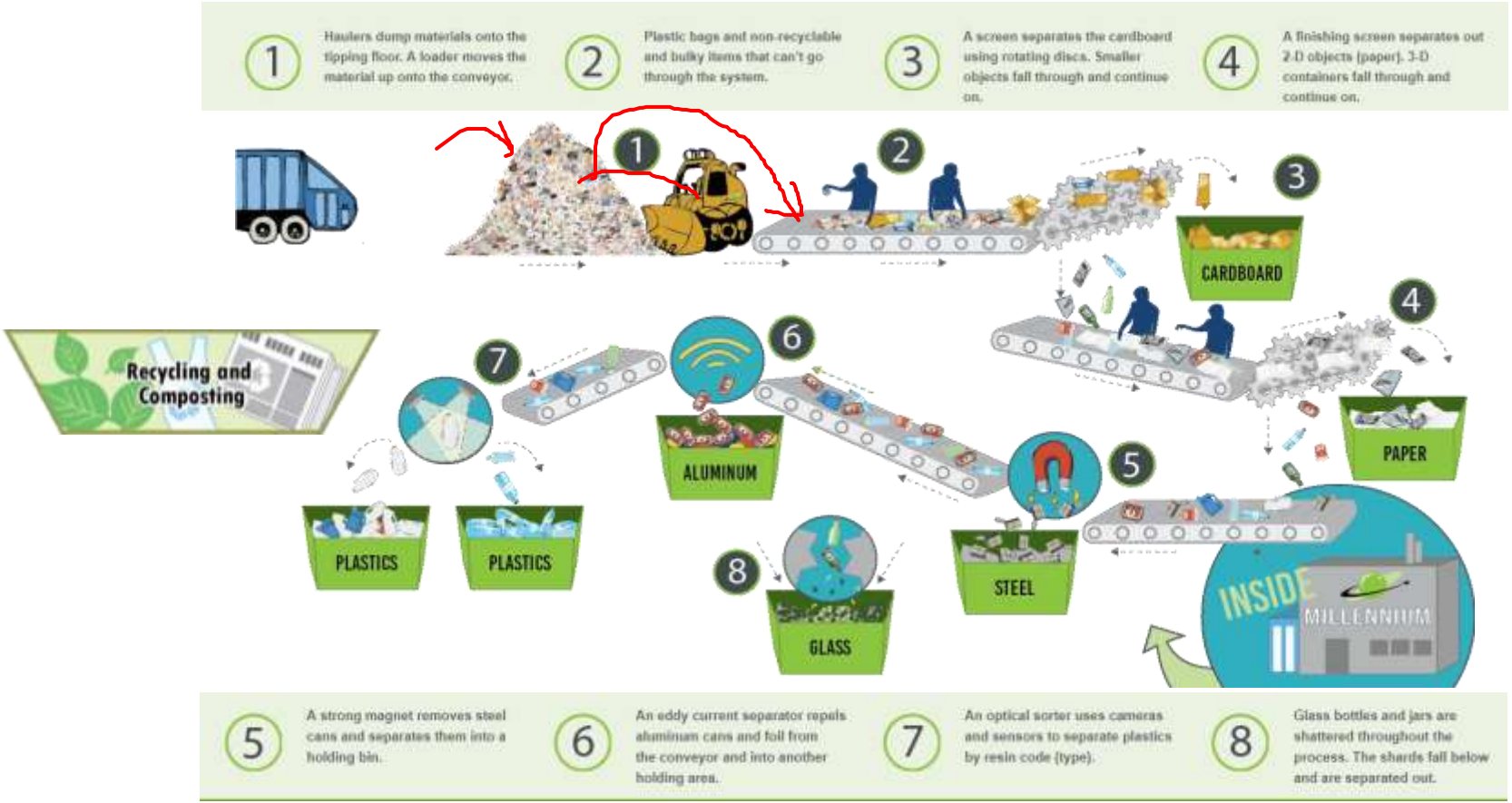
- EPA estimates that 50% of the waste quantity can be reduced with source reduction
- Should not be a substitute of one problem for another
- Packaging is 50% of waste volume and 1/3 of waste weight
  - Paper and plastics
  - Spend more on food packaging than farmers net income
  - Replace with smaller, lighter, degradable material

Source reduction



https://www.epa.gov/toxics-release-inventory-tri-program/measuring-impact-source-reduction

Segregation of waste in MRF

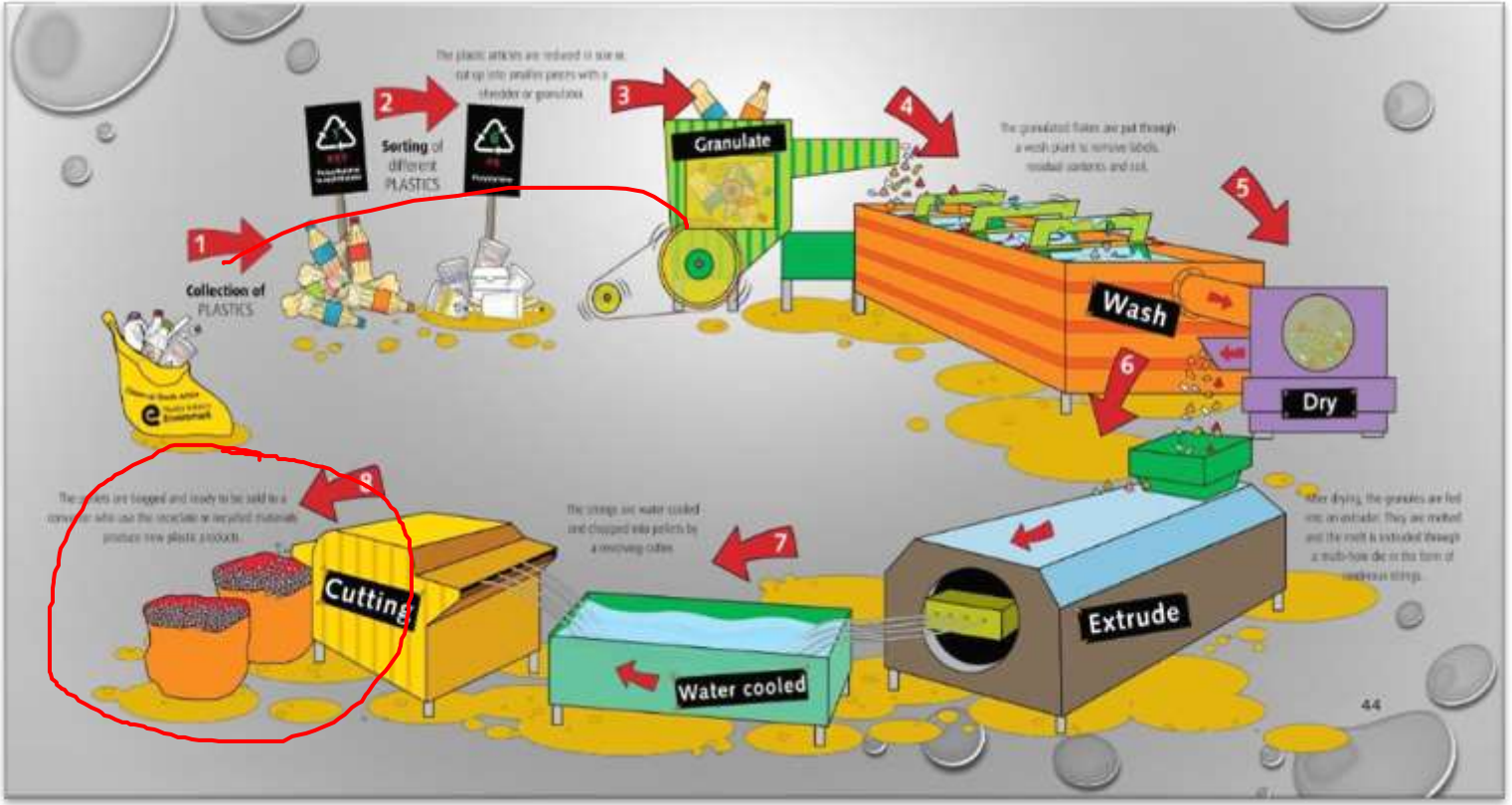


Source: https://www.millenniumrecycling.com/process/

Recycling

Recycling and Composting

Returning of raw material to market



Typical Mechanical Recycling process of plastic waste

Source: https://www.packagingsa.co.za/info-library/packaging-types/plastics/the-plastics-recycling-sequence/

Recycling

Pros:

- Save precious resources
- Lessens need for mining of virgin materials
- Lowers environmental impact of mining/processing
- Stretch landfill capacity
- Improves efficiency of incinerators and composting facilities

Cons:

- Poorly managed sites can result in Superfund sites
- Waste oil recycling, newspaper de-inking, solvent and metal recycling
- Can result in contamination of soil, groundwater, air
- Require stable market
- Only works if it is convenient
  - Curbside pick-up
  - Drop off centers
  - Mail back programs

Composting

- Natural decomposition of organic material
  - Need organic, water, oxygen
  - Not use preserved wood, human wastes, bones, meat, fat, certain weeds
- Individual
- Municipal
- **Major factors of consideration**: Temperature and pH
- **Major Types**: windrow composting & aerated static pile composting

Composting

https://www.open.edu/openlearncreate/pluginfile.php/170069/mod_oucontent/oucontent/13842/90723551/2f744a9c/m4_ss8_fig8.4.jpg

Waste to Energy

Conversion Technologies

Through

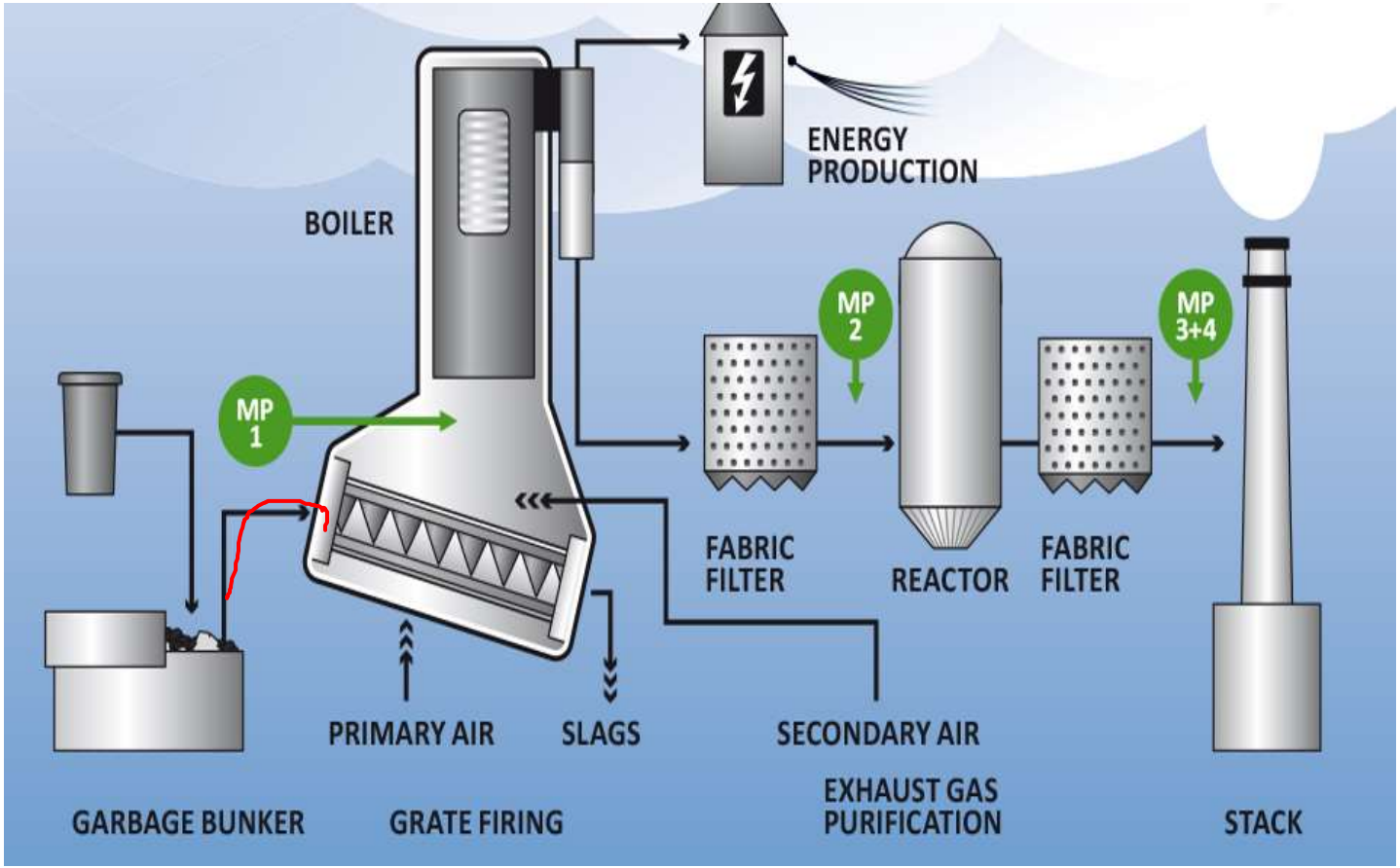
- Heat
- Electricity
- Co-generation (harnessing of useful heat and electricity from one power plant)

The two most common types of combustion that are used at these facilities are;

- Mass Burning / Preparation
- Combustion of Refuse Derived Fuel (RDF)

Typical waste to energy plant

Conversion Technologies



https://wasteadvantagemag.com/evolution-of-integrated-solid-waste-management-systems-enhanced-with-municipal-utilities-and-green-energy-production/

Conversion technologies

Conversion Technologies

Mass Burning / Preparation

- MSW enters the facility and is inspected for the presence of non-combustible, hazardous, and explosive materials. These materials are separated from the waste stream
- The waste stream is then fed into the combustion chamber along with forced air for "processing".
- Some of these facilities can process 3000 tons of MSW a day. They can however be scaled down to a smaller size if necessary

Combustion of RDF

- All hazardous, iron containing or otherwise non-combustible materials are removed from the waste stream.
- The remainder of the waste stream is shredded
- The material is then burned or further processed into pellets or cubes to be used as fuel in other furnaces
- In some instanced the materials can be processed and packaged for re-sale to other facilities for use as fuel

Waste to Energy

PROS:

- Reduce volume of waste
- Recover useful energy
  - Steam
  - Waste heat
- Incinerator ash can be used in building material

CONS:

- Cost
- High degree of sophistication needed to operate safely and economically
- Public perception of safety
  - Stack emissions
  - Toxicity of ash

Landfilling

- Concept fostered in early 20th century
- An area of land that has solid waste deposited on it in such a quantity to noticeably change the surface elevation.
- 50-70% of municipal solid waste is landfilled.

Advantages

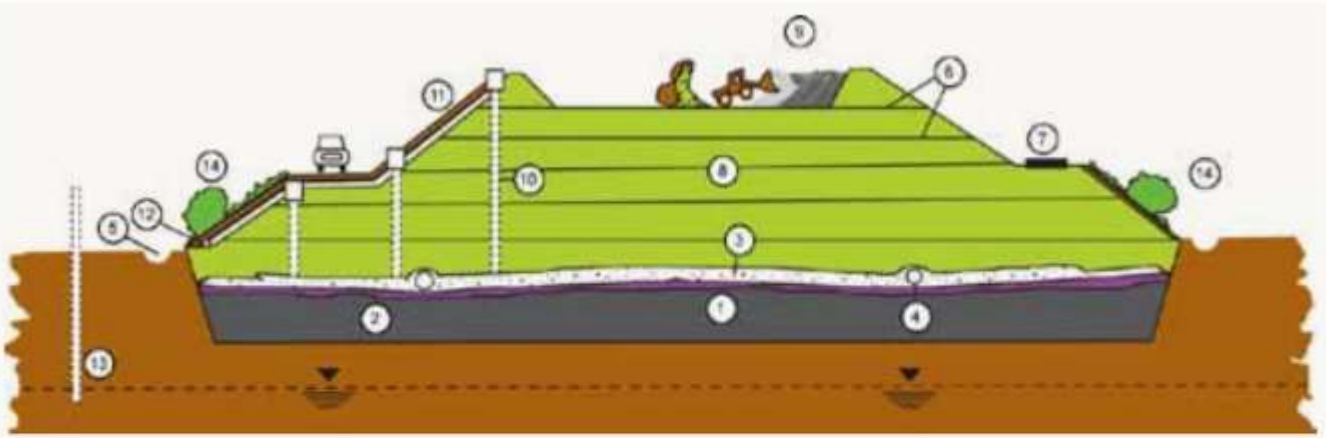
- Carbon sequestration ?
- Easy and cheap solution !!
- Nutrients from leachate ?
- Energy from landfill gas ?
- A quick fix solution for hazardous and infectious waste ?

Dumpsite vs Landfill

- Dumps are open places where trash is buried and where animals swarm.
- They offer no environmental protection and are not regulated.

- Landfills are carefully designed and monitored structures that isolate trash from the surrounding environment.
- They typically use a bottom liner and daily covering of soil.

Components of a sanitary Landfill



1. Geological barrier
2. Impermeable base liner
3. Drainage layer
4. Leachate collection system
5. Storm - water drain ditch
6. Bordering dams
7. Circulation roads
8. Landfill body
9. Filling and compacting in layers
10. Gas venting system
11. Protective cover system
12. Gas collectors
13. Grondwater control
14. Re-planting

https://smartnet.niua.org/sites/default/files/resources/Book%201.pdf

Problems associated with Landfilling

- Physical amount and disposal sites
- Costs to collect, handle, and dispose
- Litter
- Odor
- Insects (flies, cockroaches) & rodents
  - food
  - harborage
- Resource lost

Sustainable practices in waste management

- Expand sanitary waste disposal and landfill management
- Develop infrastructure for waste utilization
- Integrate waste management and social inclusion
- Promote innovation in waste collection services
- Support development of market economy for waste recycling
- Use digital mapping to manage solid waste
- Ensure and implement integrated waste management systems

https://c40-production-images.s3.amazonaws.com/good_practice_briefings/images/9_C40_GPG_SSWS.original.pdf?1456789082

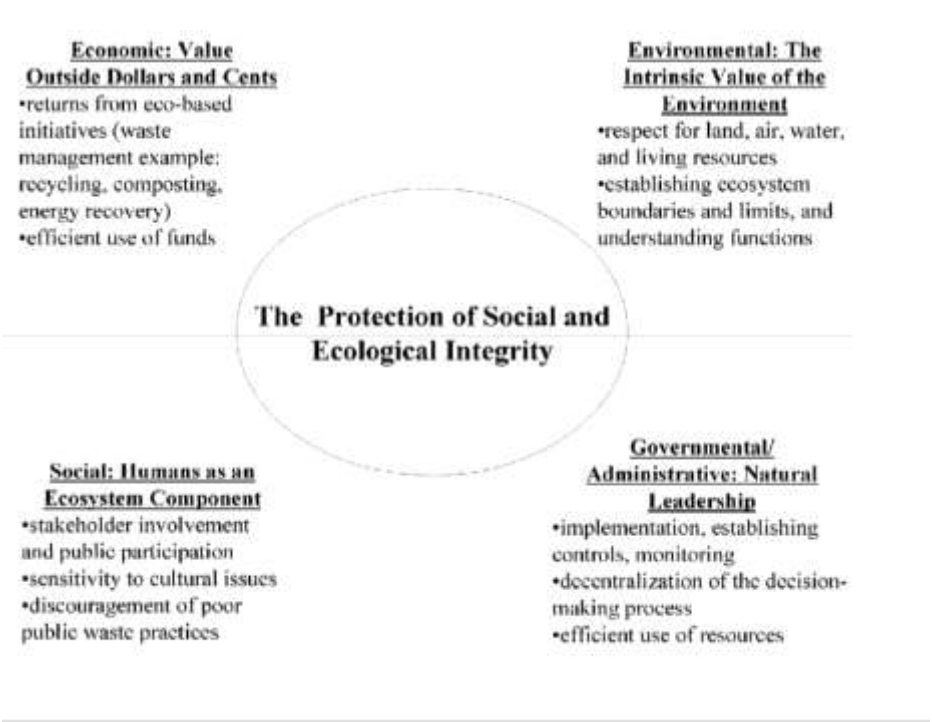
Sustainable practices in waste management

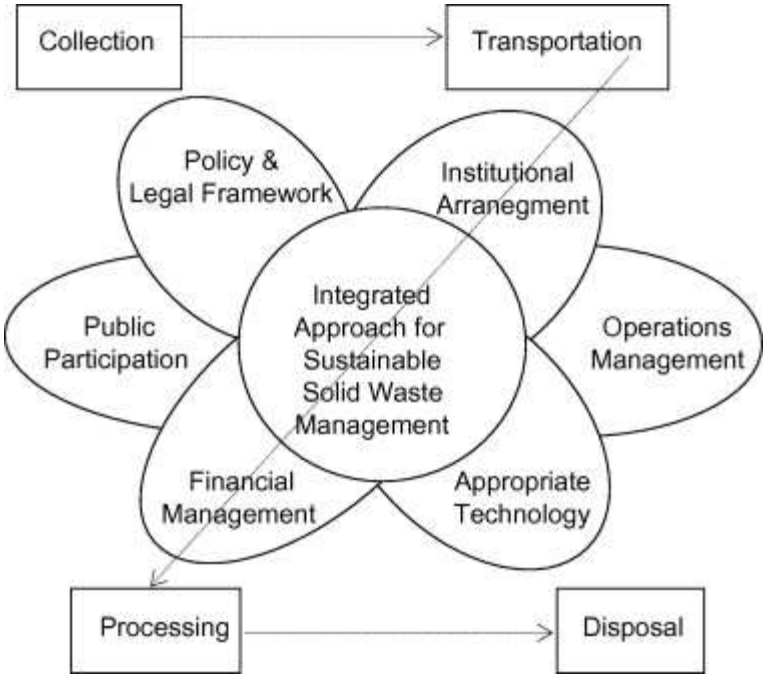
https://www.gjesm.net/article_39143.html

Sustainable practices in waste management

https://www.torontoenvironment.org/zerowaste_benefits

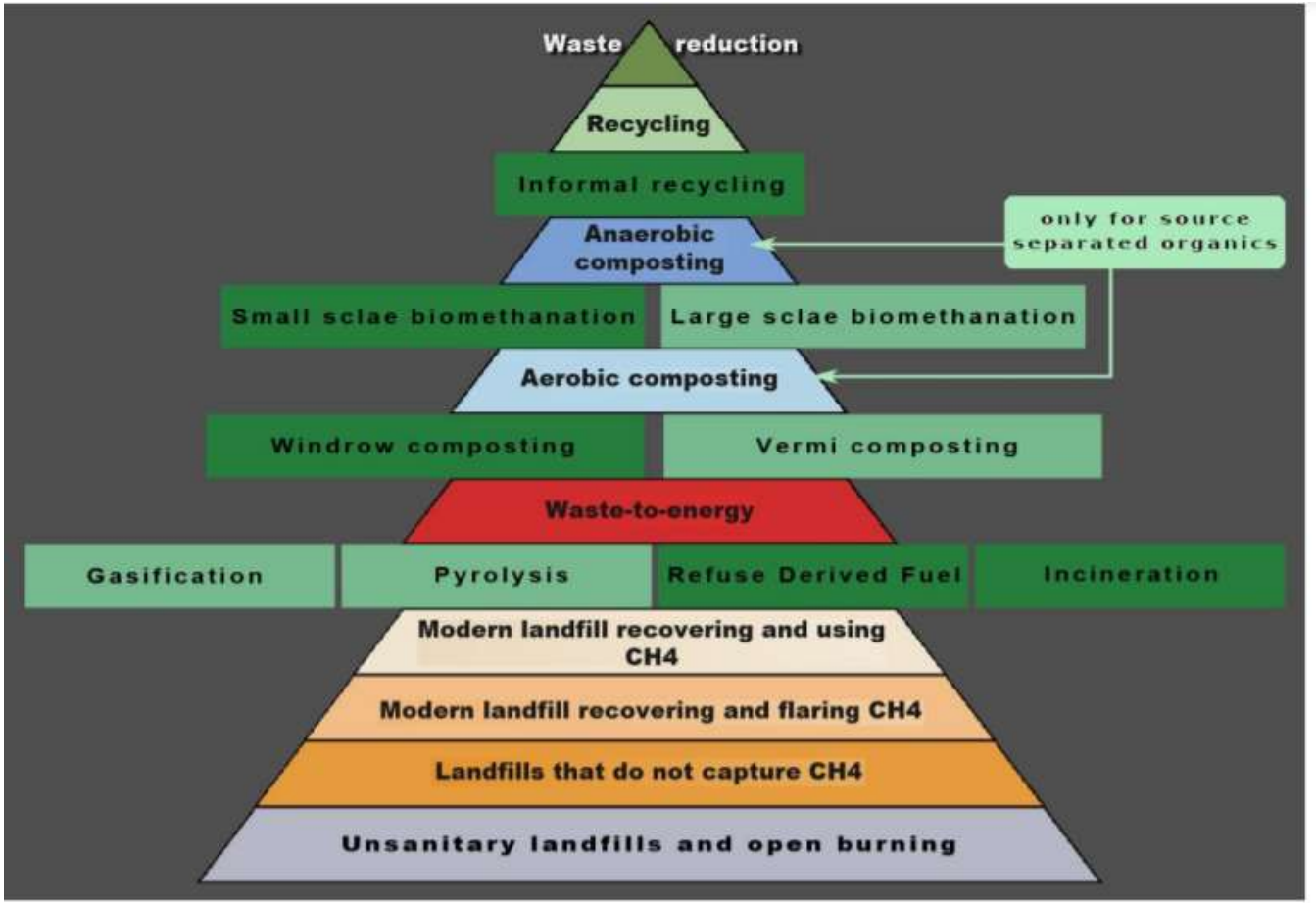
Sustainability in waste management





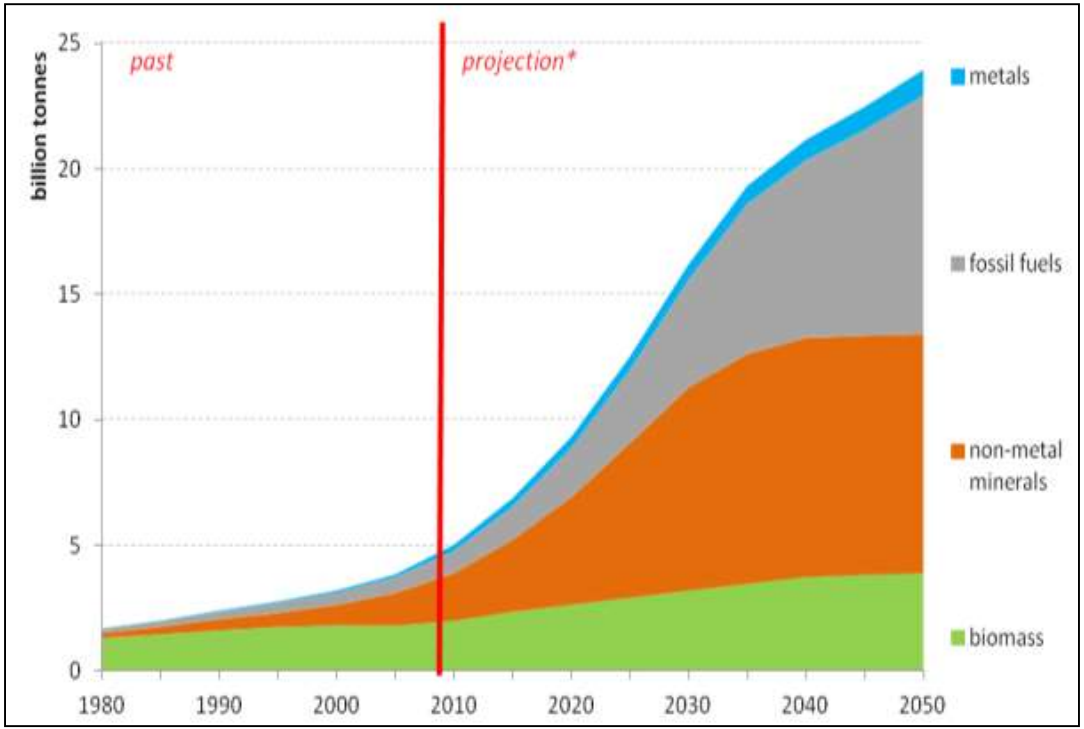
https://www.researchgate.net/publication/250276608_Governing_solid_waste_management_in_Mazatenango_Guatemala_Problems_and_prospects/figures;
https://www.sciencedirect.com/science/article/pii/S0956053X08003024

Hierarchy of Sustainable waste management



http://nswai.com/docs/Sustainable%20Solid%20Waste%20Management%20in%20India_Final.pdf

Past and projected future resource use in India



Past and projected future resource use in India (Source: based on data from Dittrich, 2012; SERI, 2012; World Bank, 2012; UN Population Statistics, 2012, IGEP 2013, Cited from: Framework for the Indian Resource Panel, 2015)

- Finite resources such as metals and minerals will become more expensive as their extraction becomes more difficult
- The resulting supply constraints will put great pressure on productive sectors
- The future needs of India for resources and its dimensions and challenges, such as resource availability and access, affordability and sustainability make it clear that resource-efficient production processes and the use of secondary materials are inevitable to meet both growing demand and supply constraints (FIRP, 2015)

Timeline chart

1880

Dumping waste at sea in New York Harbor, a common practice

1900

Early 1900s refuse collection wagon used in America

1948

Federal Water Pollution control act

1964

Post-war Period - 1964: "With prosperity again, we really need to do something. But what?"

1965

Solid Waste Disposal Act

1970

Resource Conservation Recovery Act

1976

RCRA again revised

1980

Management of Hazardous waste

1984

Hazardous and Solid waste Amendment

1986

Environmental Protection Act

1989

Hazardous Waste (Management & Handling)

2000

Municipal Solid Waste (Management & Handling)

1998

Bio Medical Waste (Management & Handling)

2001

Batteries (Management & Handling)

2011

E waste & Plastic waste (Management & Handling)

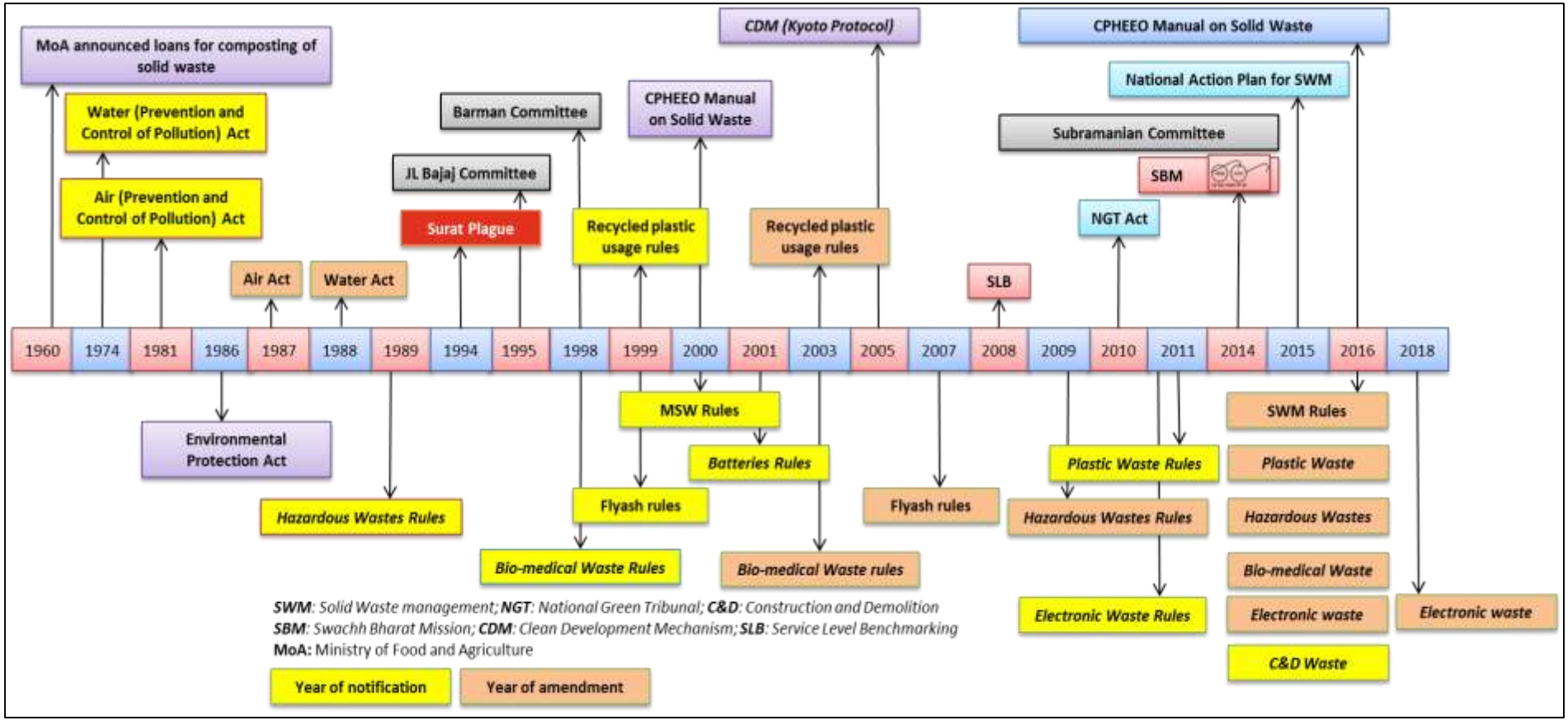
2016

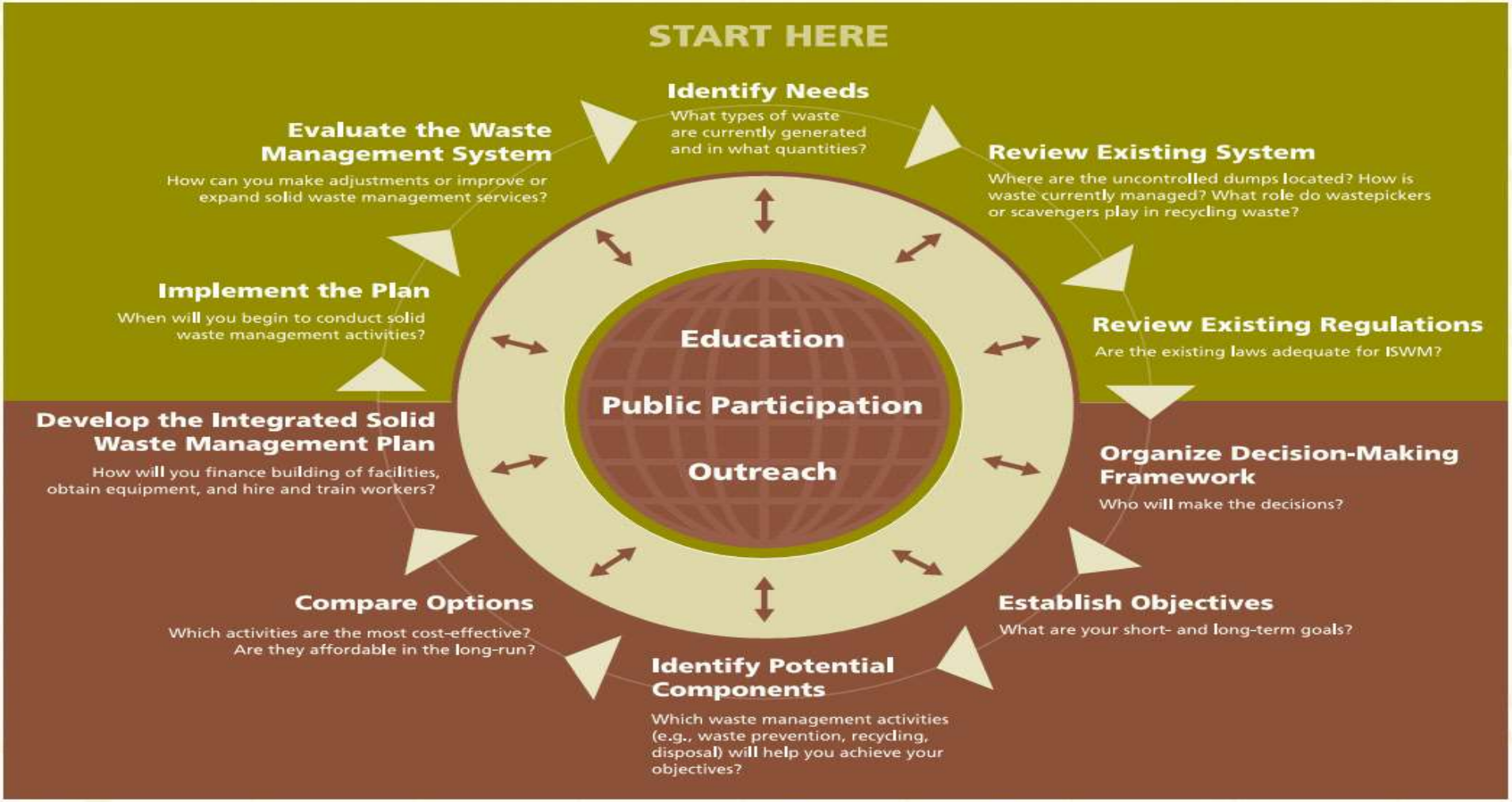
E waste, Plastic waste, MSW, Bio Medical waste ,Construction and Demolition waste, Hazardous waste Rules

World Scenario

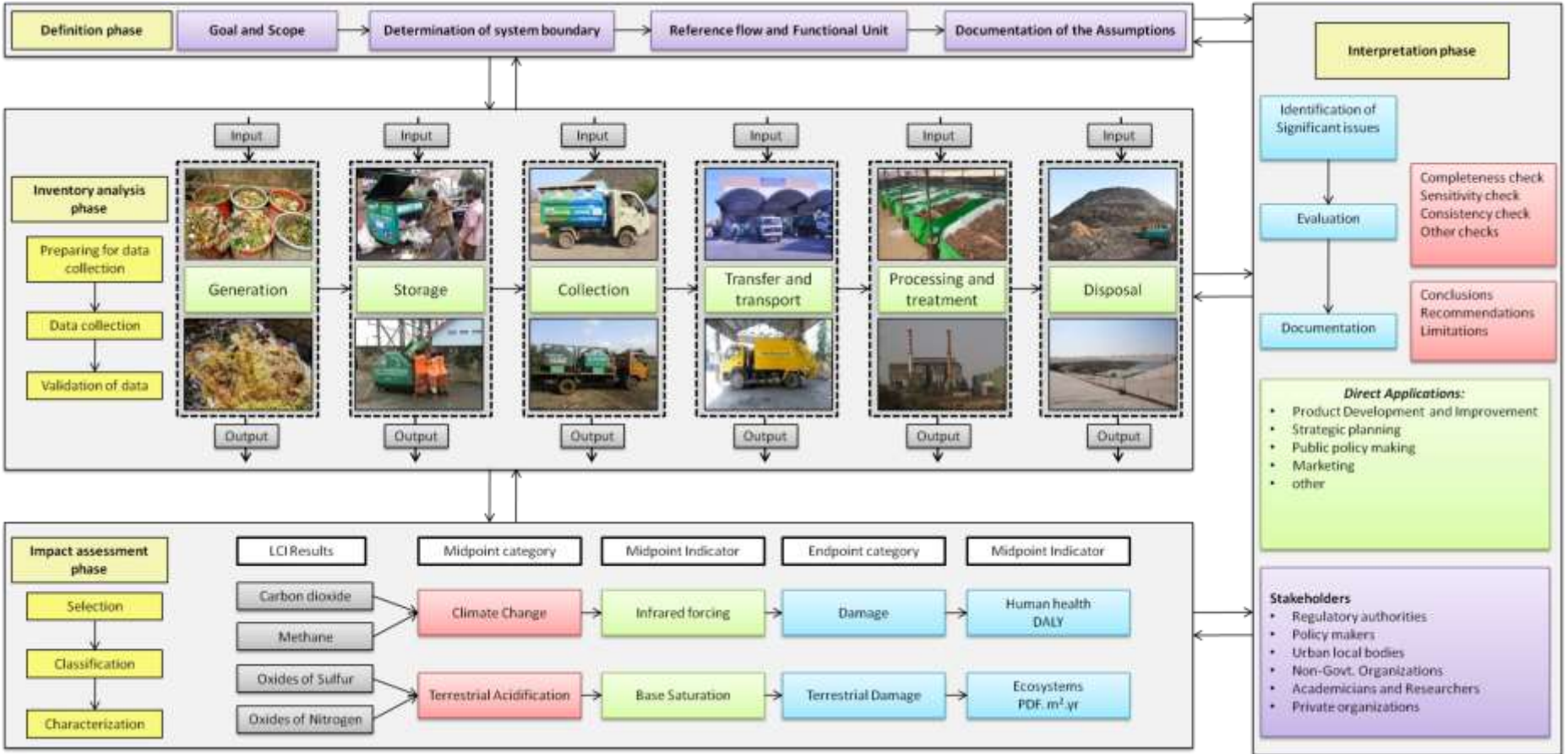
India Scenario

Timeline chart of waste management policies and activities in India

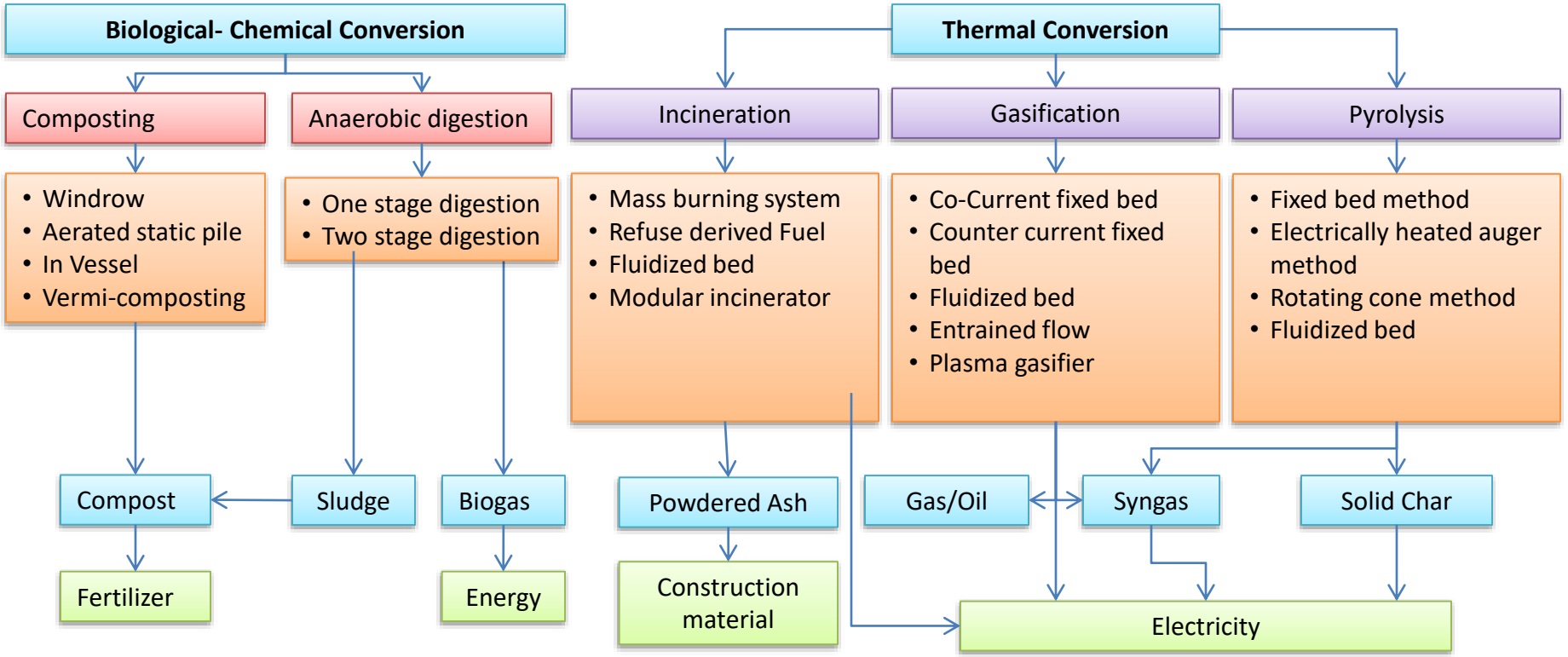



START HERE
Identify Needs
What types of waste are currently generated and in what quantities?
Review Existing System
Where are the uncontrolled dumps located? How is waste currently managed? What role do wastepickers or scavengers play in recycling waste?
Review Existing Regulations
Are the existing laws adequate for ISWM?
Organize Decision-Making Framework
Who will make the decisions?
Establish Objectives
What are your short- and long-term goals?
Identify Potential Components
Which waste management activities (e.g., waste prevention, recycling, disposal) will help you achieve your objectives?
Compare Options
Which activities are the most cost-effective? Are they affordable in the long-run?
Develop the Integrated Solid Waste Management Plan
How will you finance building of facilities, obtain equipment, and hire and train workers?
Implement the Plan
When will you begin to conduct solid waste management activities?
Evaluate the Waste Management System
How can you make adjustments or improve or expand solid waste management services?
Education
Public Participation
Outreach

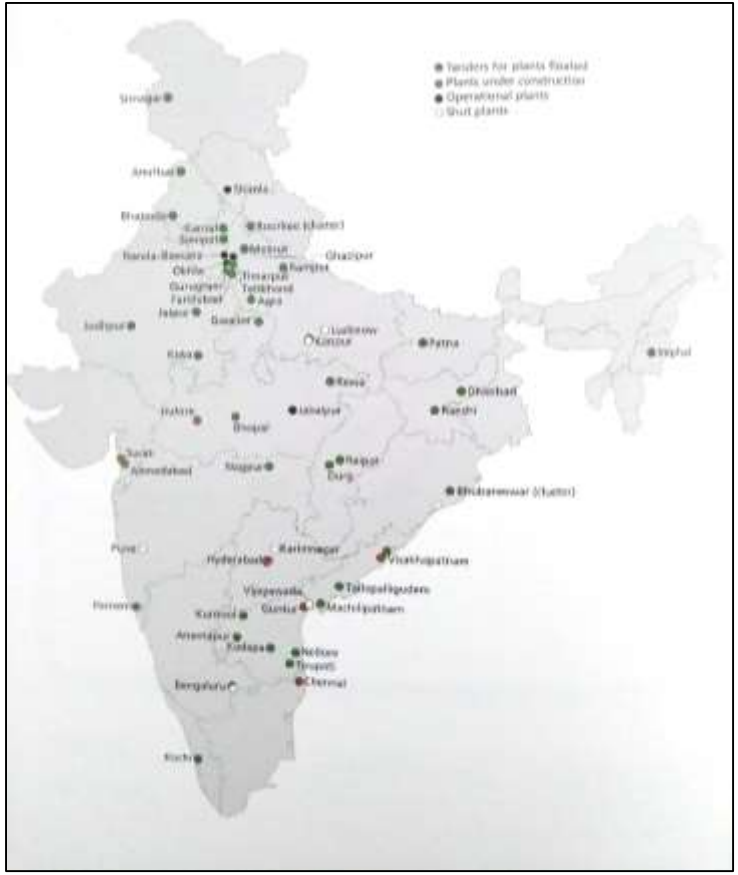
Life Cycle Assessment (LCA)

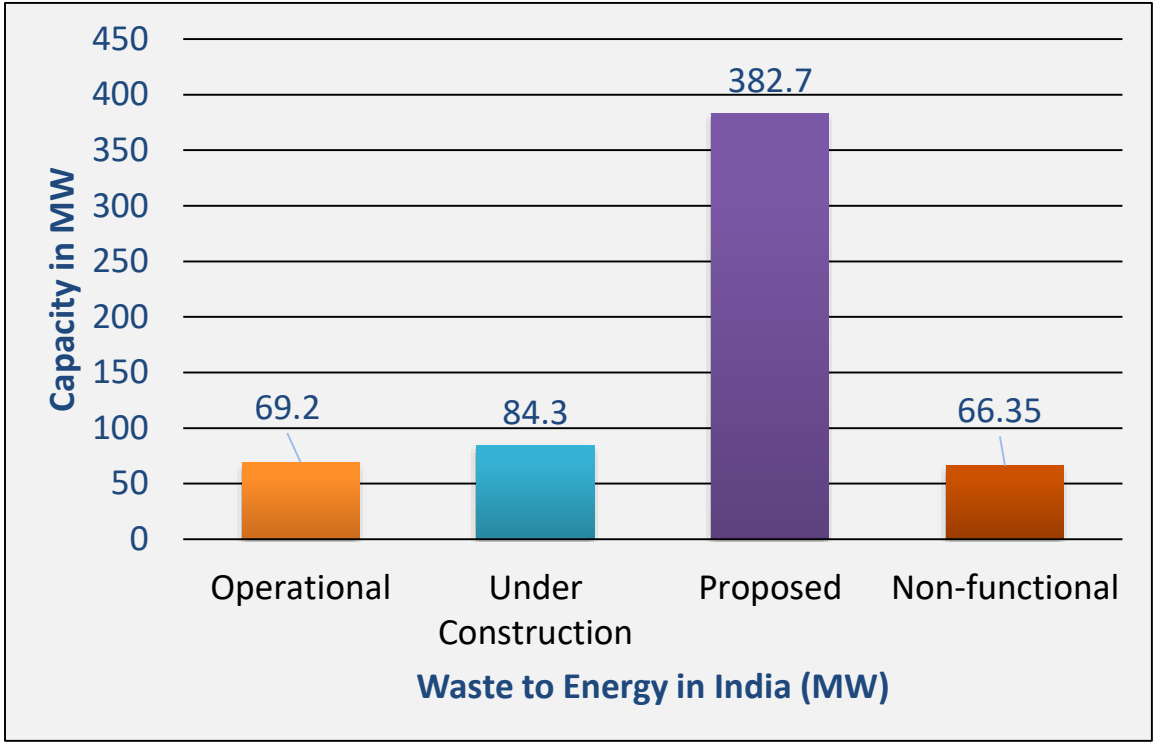


Identification of treatment technologies



Waste to Energy in India





Source: *Sambyal, S. S., and Richa, A. 2018. To burn or not to burn: Feasibility of Waste to Energy Plants in India. CSE Publishers, India*

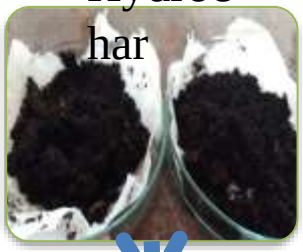
HTC of the organic fraction of MSW

Yard Waste

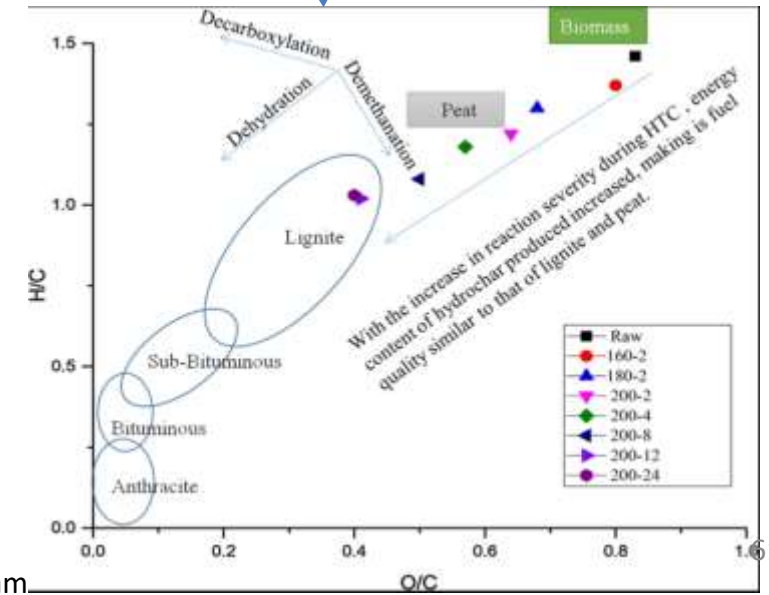
Food

Reactor

Hydrochar

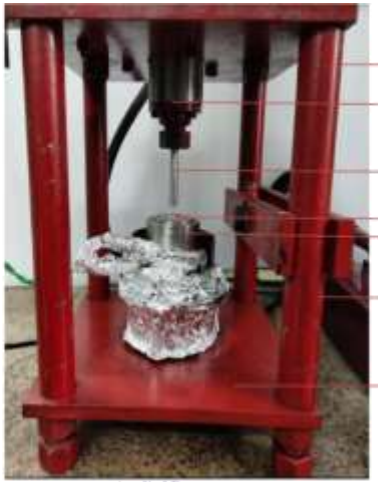


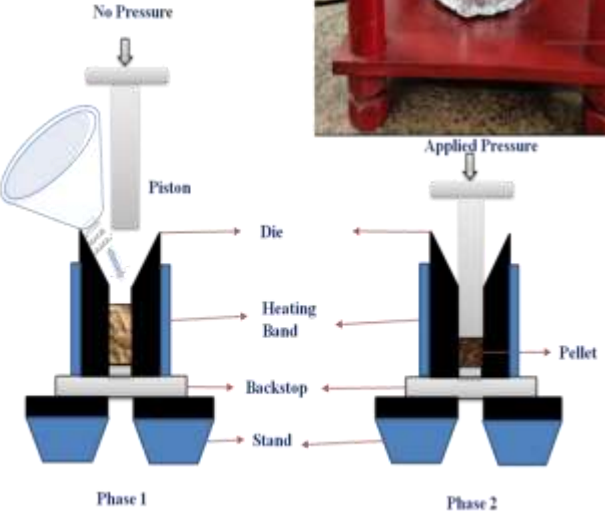
Fuel Pellets



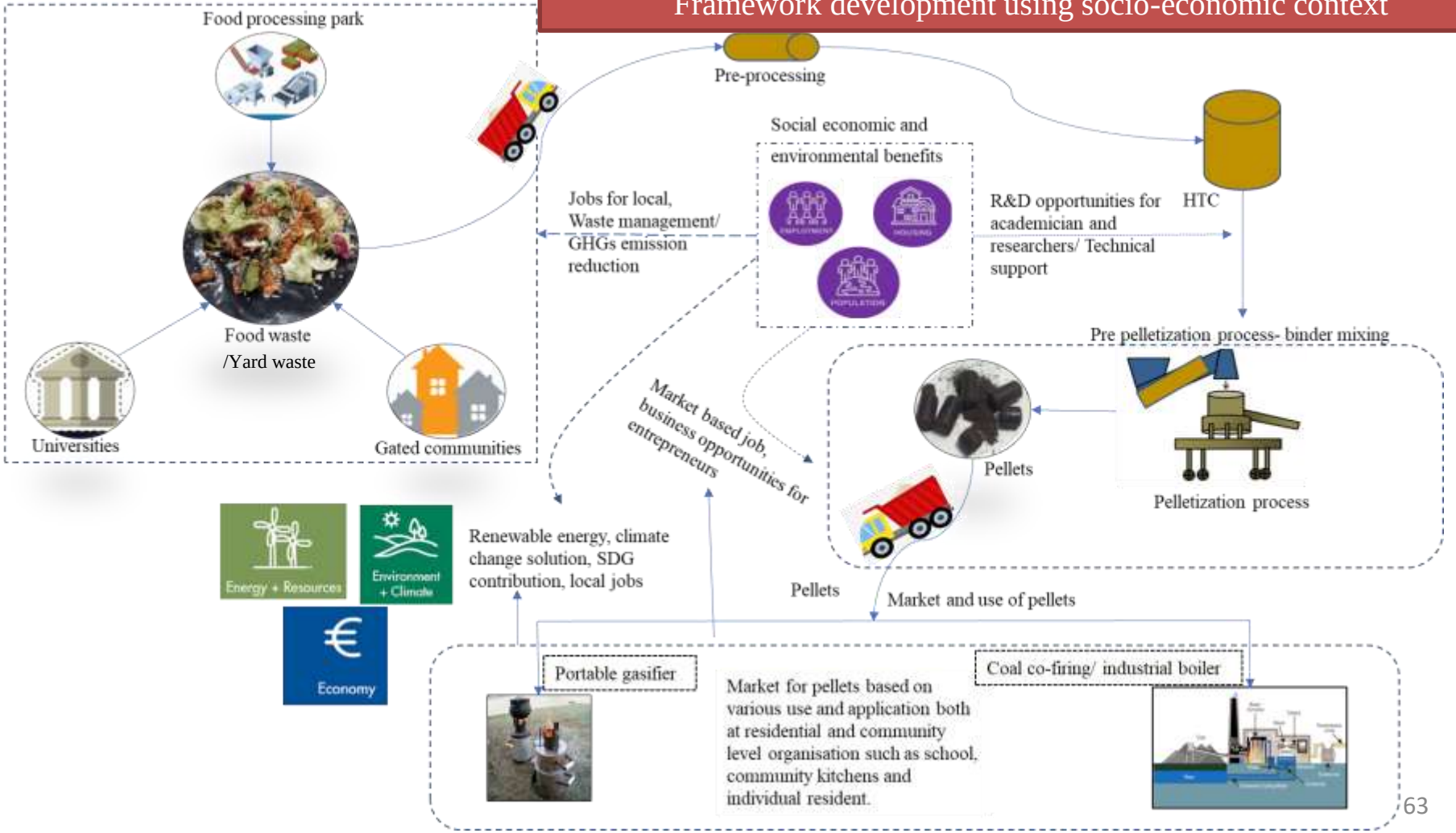
Van Krevelen diagram

Pelletization using self design pelletiser

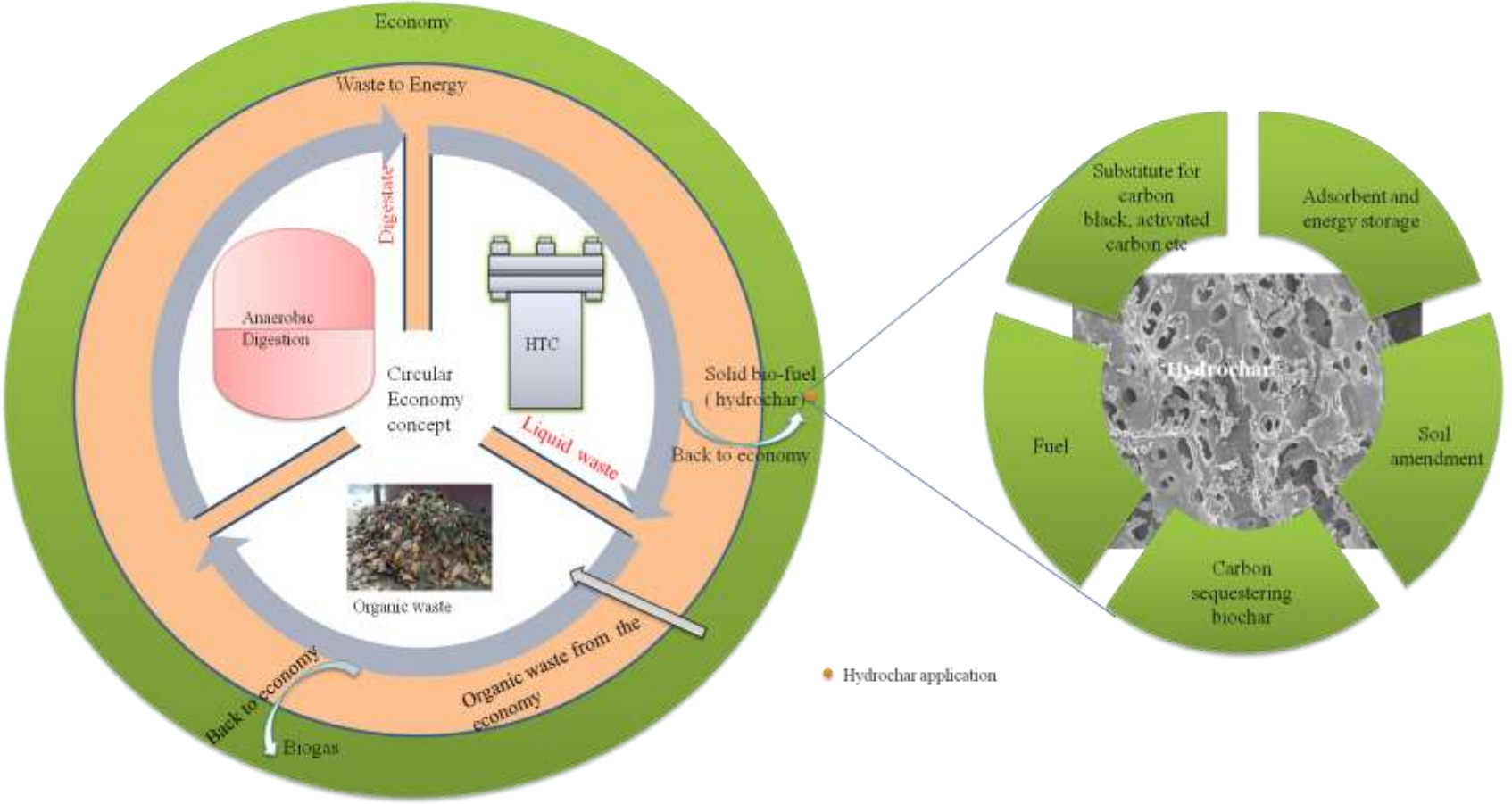




Framework development using socio-economic context



Application of hydrochar



Loop the waste into energy sector
Hydrothermal Carbonization _ Future of waste to energy

Hari Bhaktha Sharma – Future CM (Carbonization Man)

Media Coverage of Research

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News / Education Today / News / IIT Kharagpur researchers develop 'zero loss' process for wet municipal solid w

IIT Kharagpur researchers develop 'zero loss' process for wet municipal solid waste management

India Today Web Desk
New Delhi
July 31, 2019 UPDATED: July 31, 2019 16:39 IST

DD NEWS DD न्यूज

National International Business Sports Entertainment Sci-Tech Health

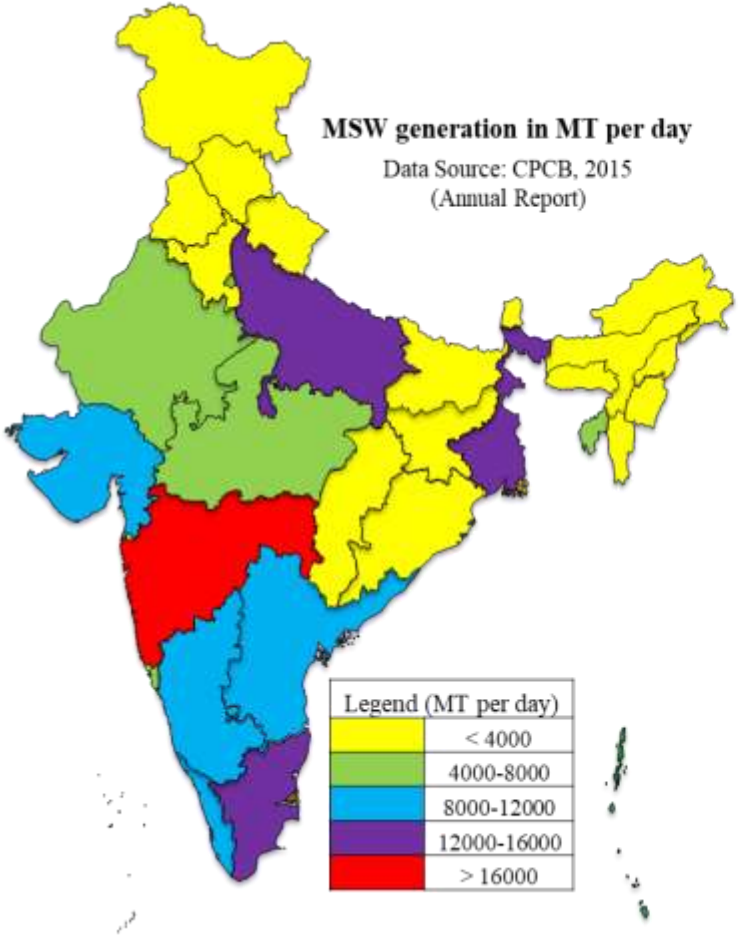
Home | People | IIT-KGP researchers develop tech for solid waste management

IIT-KGP researchers develop tech for solid waste management

01-08-2019 | 10:22 am

A research team at IIT Kharagpur has developed a technology which can generate energy from solid waste with high moisture content.

Solid Waste Management in India

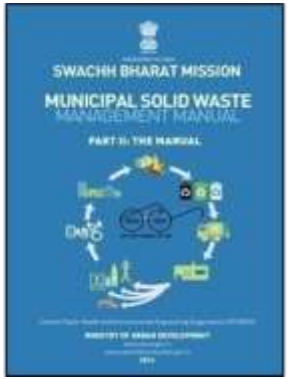


S. No	Item	Description	Source
1	Solid waste generation in India	62 million tonnes annually	PIB, 2016
2	Percentage of waste being collected	70%	
3	Percentage of waste being treated	22 – 28% of the collected waste	
4	Status of remaining collected waste	Dumped in unlined landfill	
5	Compost and vermi-compost units	553	CPCB, 2015
6	Bio-methanation plants	56	
7	Refuse Derived fuel plants	22	
8	Waste to Energy plants	13	

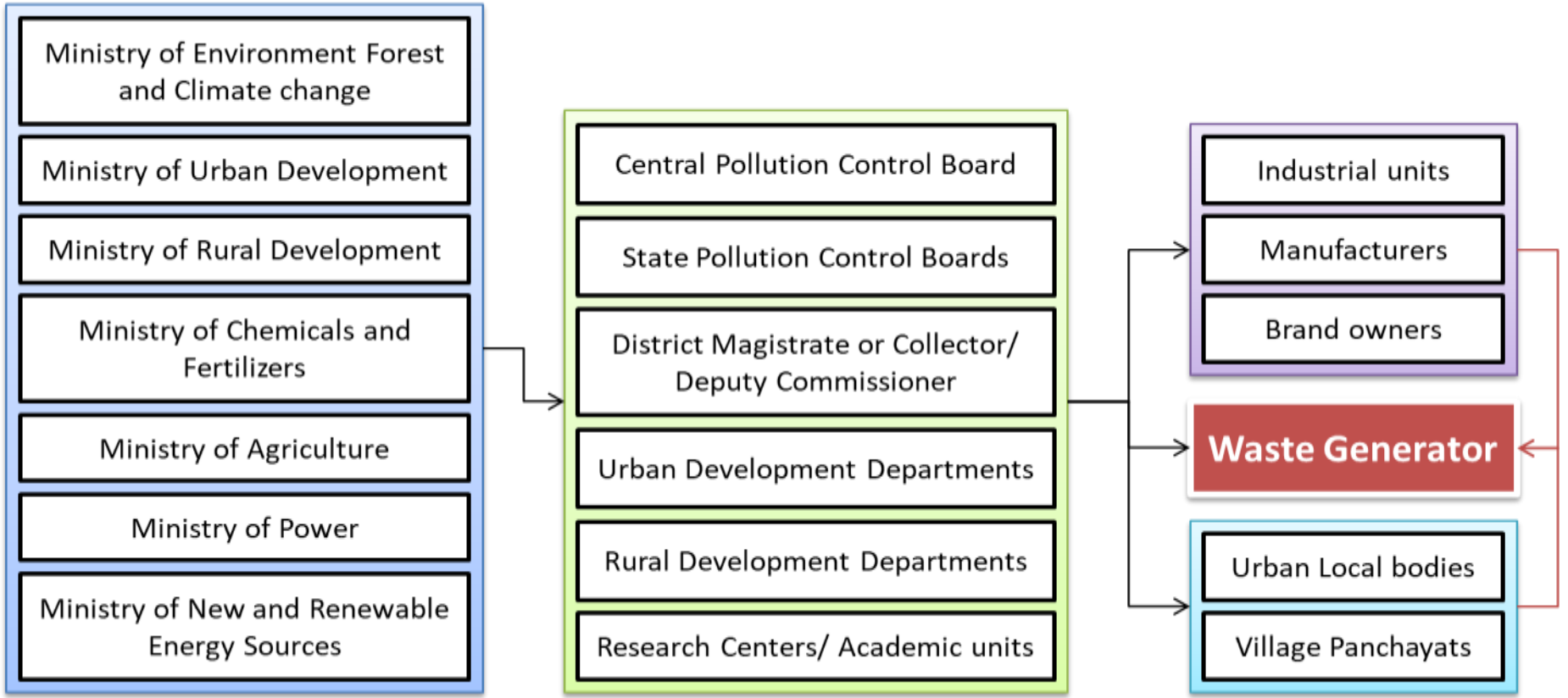
***PIB**: Press Information Bureau; **CPCB**: Central Pollution Control Board*

Solid Waste Management rules in India

- To enhance the existing waste management practices, Government of India conglomerated policies and structure for solid waste management. They are entitled as Solid Waste Management (SWM) rules 2016.
- Selection Criteria for waste processing technologies was drafted by CPCB in compliance with National Green tribunal.
- A manual is developed by Ministry of Urban Development, which provides stepwise guidance to local authorities in development of solid waste management systems (CPHEEO, 2016).



Organizational structure



Salient features of SWM 2016

1. The **source segregation of waste** has been mandated to channelize the waste to wealth by recovery, reuse and recycle.
2. Responsibilities of Generators have been introduced to segregate waste in to three streams, **Wet, Dry and domestic hazardous wastes** and handover segregated wastes to authorized rag-pickers or waste collectors or local bodies.
3. Generator will have to pay "**User Fee**" to waste collector and for "**Spot Fine**" for Littering and Non-segregation.
4. The concept of **partnership in Swachh Bharat** has been introduced. **Bulk and institutional generators, market associations, event organizers and hotels and restaurants** have been made directly responsible for segregation and sorting the waste and manage in partnership with local bodies.

Salient features of SWM 2016

5. All Resident Welfare and market Associations, Gated communities and institution with an area "5,000 sq. m" should **segregate waste at source**- in to valuable **dry waste and handover recyclable material** to either the authorized waste pickers or the authorized recyclers, or to the urban local body.

6. The **bio-degradable waste** should be processed, treated and disposed of through **composting or bio-methanation** within the premises as far as possible. The residual waste shall be given to the waste collectors or agency as directed by the local authority.

7. All **manufacturers of disposable products** who sale or market their products in such packaging material which are non-biodegradable should put in place a system to **collect back the packaging waste generated** due to their production.

8. **The concept of RDF**, and types of waste generated and the **need of WTE** is also mentioned in the Waste Management Rules, 2016.

स्वच्छ भारत
एक कदम स्वच्छता की ओर

Biodegradable

Vegetables peels
Fruit peels
Food Remains
Coffee powder
Coconut shells
Egg shells

Recyclables

Plastic
Paper
Wood
Glass
Rubber
Metal

Transition to zero waste lifestyle

https://science.howstuffworks.com/environmental/conservation/issues/deadly-1948-donora-smog-launched-clean-air-movement.htm

Transition to zero waste lifestyle

- ESTABLISH YOUR "WHY"
- ASSESS YOUR WASTE
- PRIORITIZE
- REPLACE ITEMS AS THEY RUN OUT
- RESEARCH HOW TO PROPERLY RECYLE OLD ITEMS, DONATE, SELL OR UP-CYCLE THEM
- REMEMBER: IT'S A PROCESS!

https://www.nationalgeographic.com/news/2018/05/zero-waste-families-plastic-culture/

Transition to zero waste lifestyle

https://www.vectorstock.com/royalty-free-vector/zero-waste-lifestyle-tips-for-self-care-vector-25661082
https://ecowarriorprincess.net/2018/12/5-simple-easy-tips-to-create-a-fuss-free-zero-waste-kitchen/

Transition to zero waste lifestyle

- Reducing consumption and discards
- Reusing discards
- The principle of producer accountability (including extended producer responsibility strategies)
- Comprehensive recycling
- Comprehensive composting or bio-digestion of organic materials

https://www.no-burn.org/introduction-to-zero-waste/

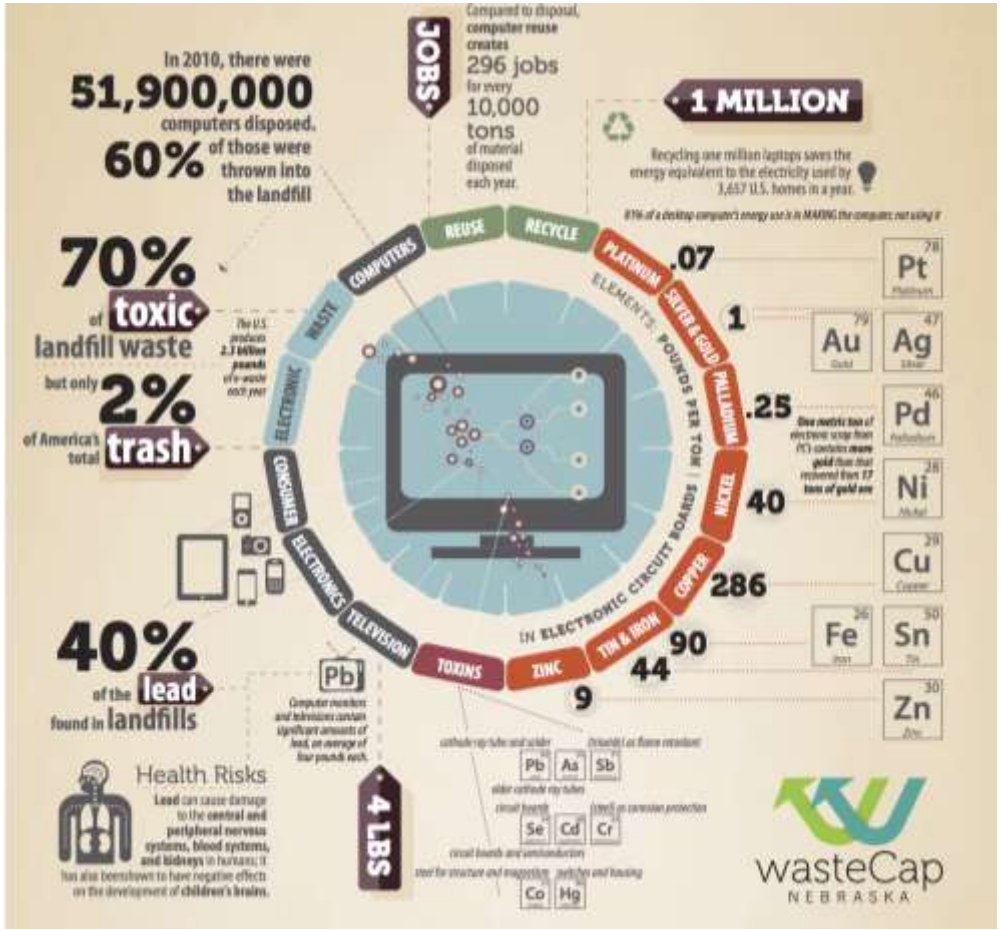
Transition to zero waste lifestyle

- Citizen participation and worker rights
- A ban on waste incineration and illegal dumping
- Systematic reduction of landfilling over time
- Effective policies, regulations, incentives, and financing structures to support these systems.

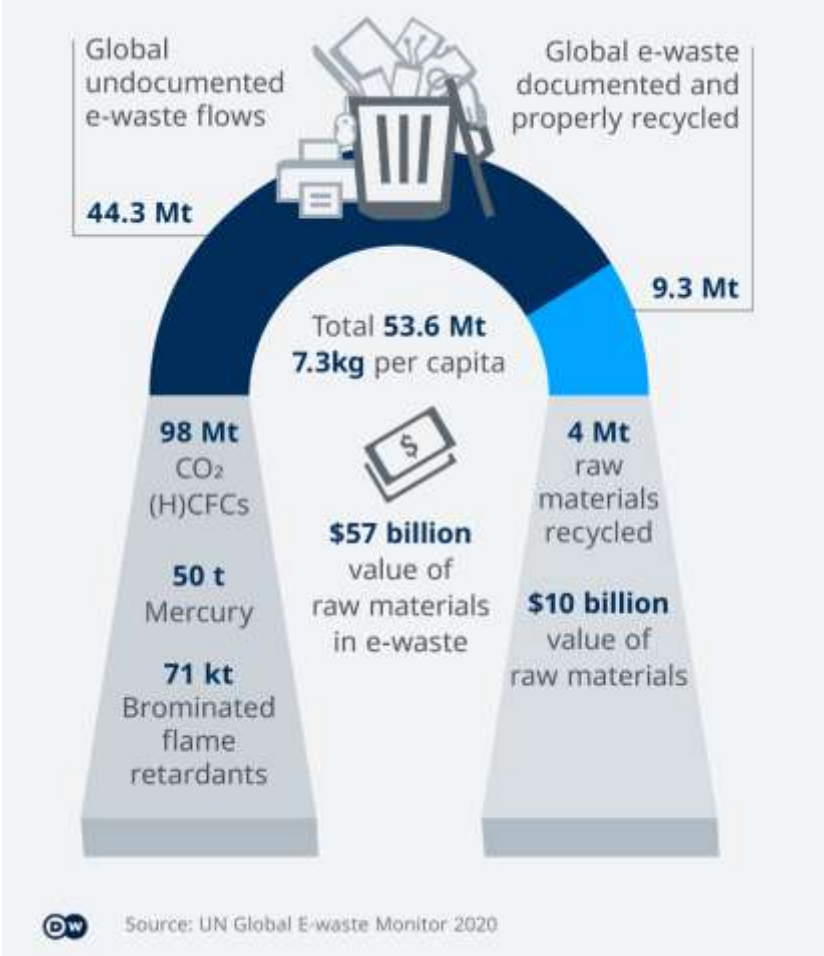
https://www.no-burn.org/introduction-to-zero-waste/

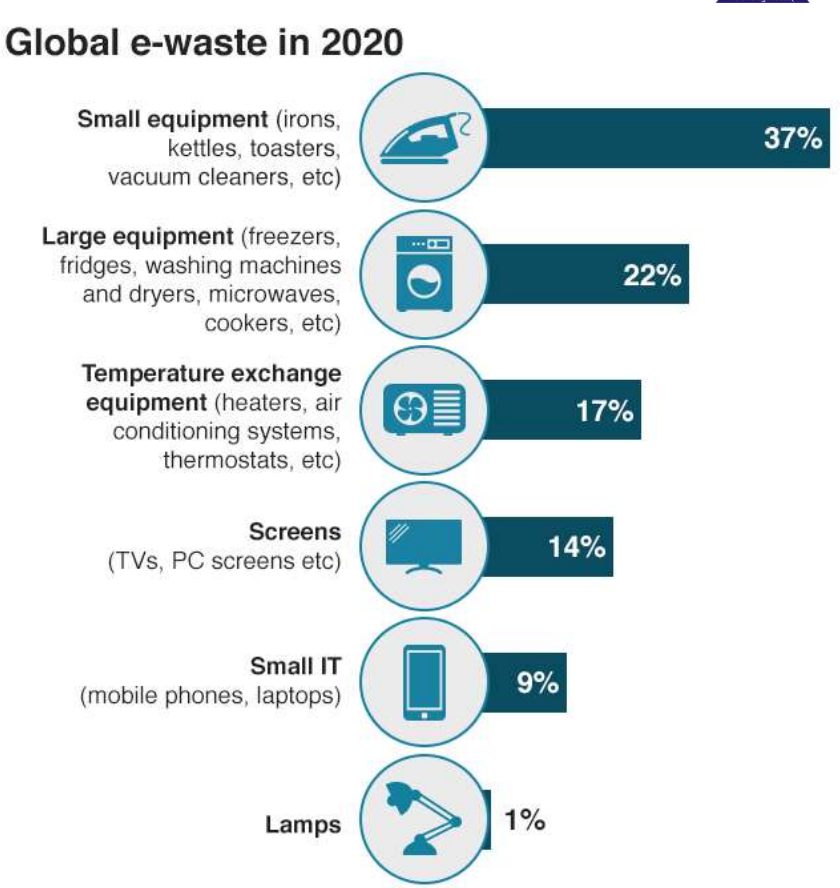
E-waste – Definition & categories

E-waste

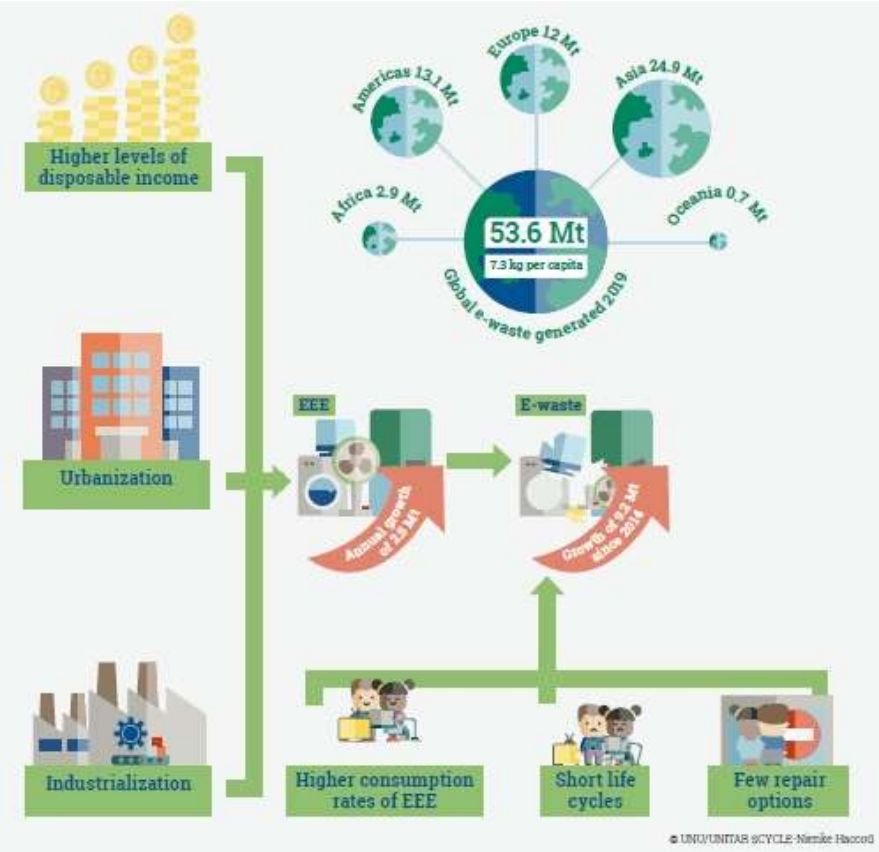

In 2010, there were
51,900,000
computers disposed.
60% of those were thrown into the landfill
70% of toxic landfill waste
but only 2% of America's total trash
40% of the lead found in landfills
Health Risks
Lead can cause damage to the central and peripheral nervous systems, blood systems, and kidneys in humans. It has also been shown to have negative effects on the development of children's brains.
4 LBS
Pb
Computer monitors and televisions contain significant amounts of lead, on average of four pounds each.
JOBS
Compared to disposal, computer reuse creates 296 jobs for every 10,000 tons of material disposed each year.
1 MILLION
Recycling one million laptops saves the energy equivalent to the electricity used by 3,657 U.S. homes in a year.
81% of a desktop computer's energy use is in MAKING the computer, not using it
COMPUTERS
REUSE
RECYCLE
PLATINUM
SILVER & GOLD
PALLADIUM
NICKEL
COPPER
TIN & IRON
ZINC
TOXINS
TELEVISION
CONSUMER ELECTRONICS
ELECTRONIC WASTE
ELEMENTS: POUNDS PER TON IN ELECTRONIC CIRCUIT BOARDS
.07
1
.25
40
286
90
44
9
Pt
Au
Ag
Pd
Ni
Cu
Fe
Sn
Zn
Pb
As
Sb
Se
Cd
Cr
Co
Hg
wasteCap
NEBRASKA

Global E-waste generation





Life cycle of E-waste



61 countries

covered by legislation, policy, and regulation

67 countries

covered by legislation, policy, and regulation

78 countries

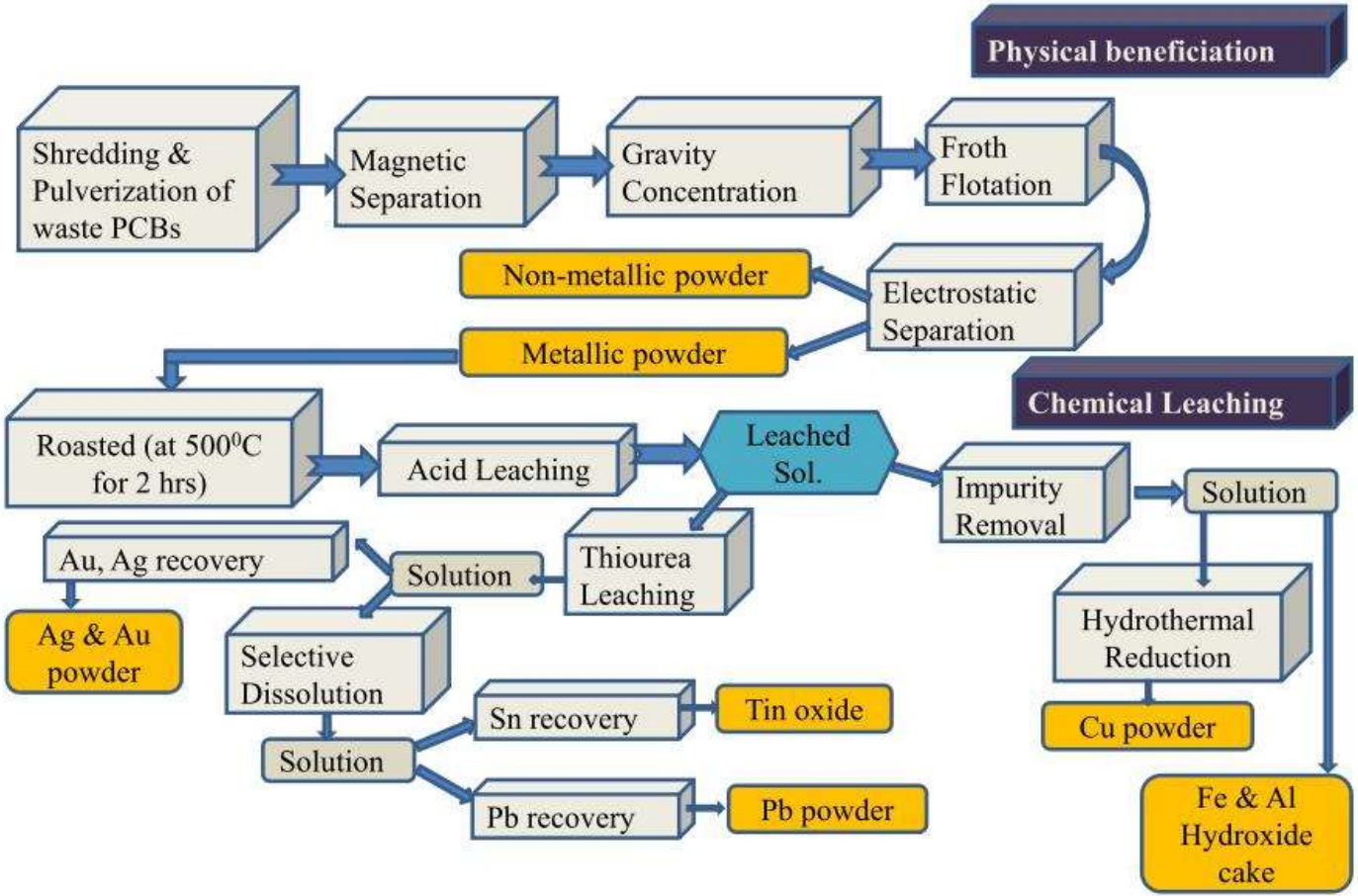
covered by legislation, policy, and regulation

© UNU/UNITAR SCYCLE-Nienke Hacco

Environmental management of E-waste

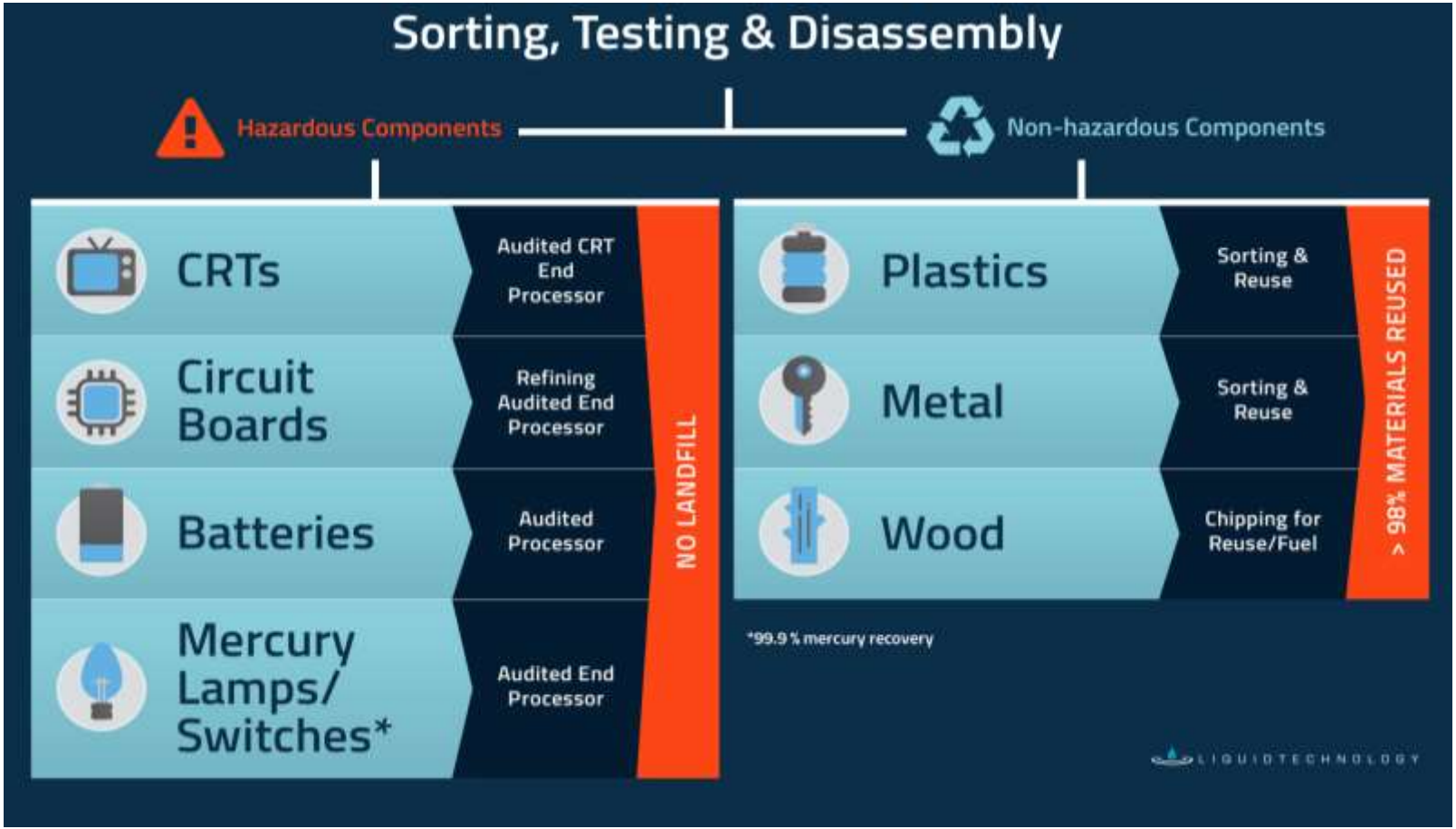
https://www.sciencedirect.com/science/article/pii/B9780128161906000054

Electronic waste management



Source: https://www.intechopen.com/books/e-waste-in-transition-from-pollution-to-resource/a-review-of-technology-of-metal-recovery-from-electronic-waste

E-waste Recycling



E-waste as a resource through metal recovery

Silver (Ag)

Gold (Au)

Palladium (Pd)

Platinum (Pt)

Rhodium (Rh)

Lead (Pb)

Nickel (Ni)

Copper (Cu)

Iridium (Ir)

Ruthenium (Ru)

Indium (In)

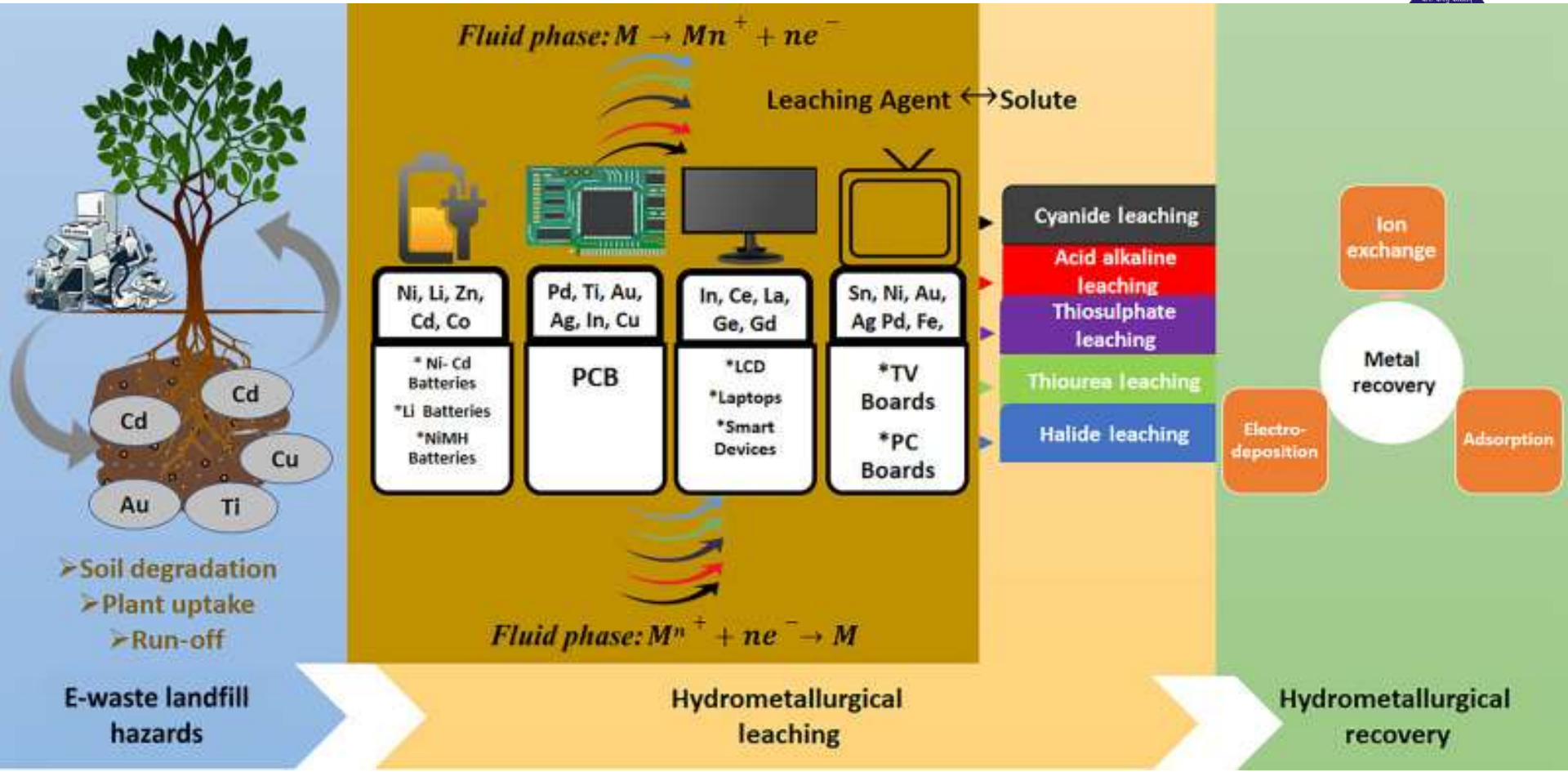
Selenium (Se)

Tellurium (Te)

Aggregate

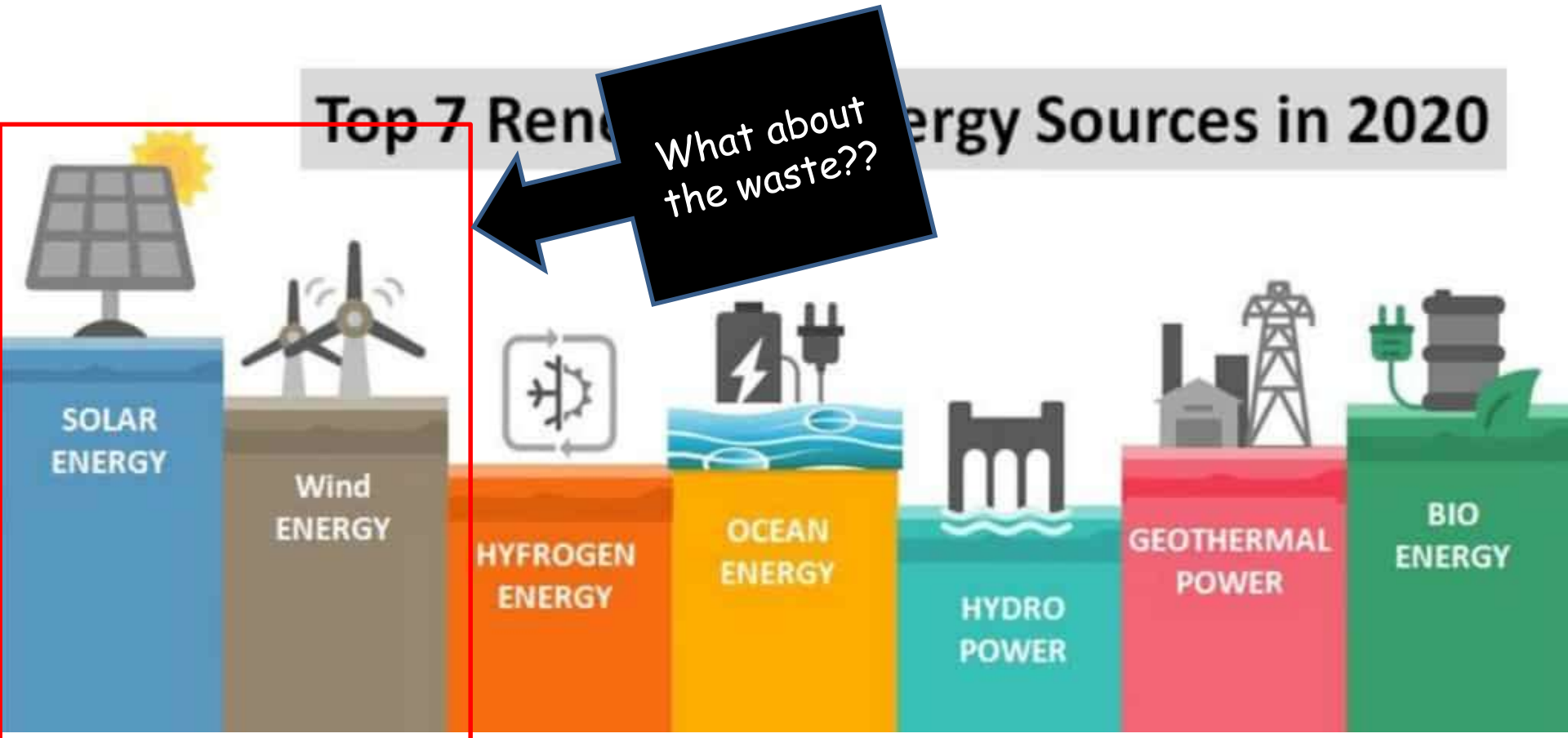
Sodium antimonate

Hydrometallurgical Recovery of Metals From E-waste



https://www.sciencedirect.com/science/article/pii/B9780128161906000108

Global renewable energy

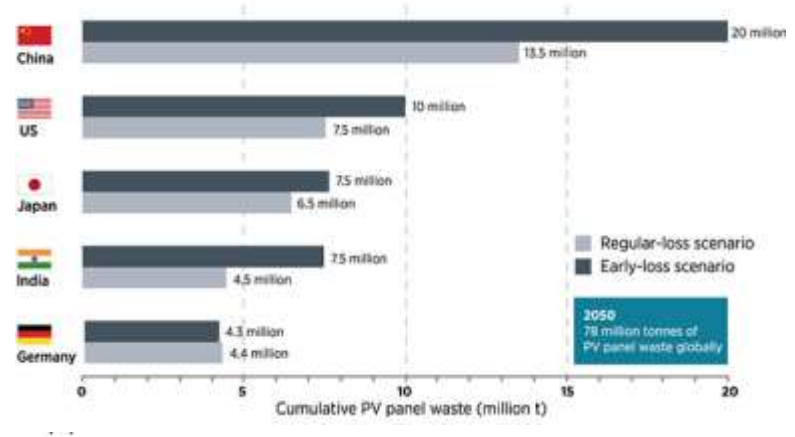


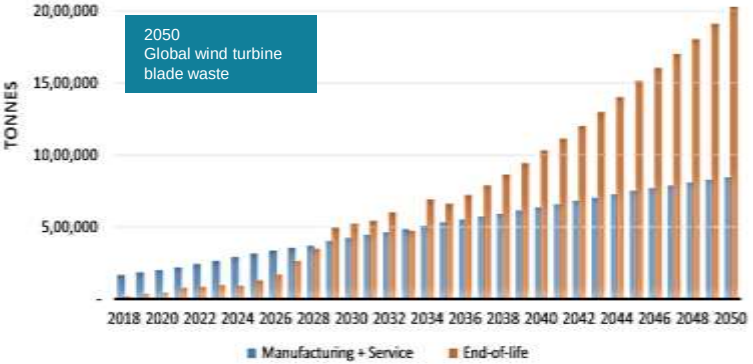
https://civiconcepts.com/2019/12/top-7-renewable-energy-sources-solar-biomass-wind-etc/

Looming waste crisis from global renewable energy

Solar panel waste

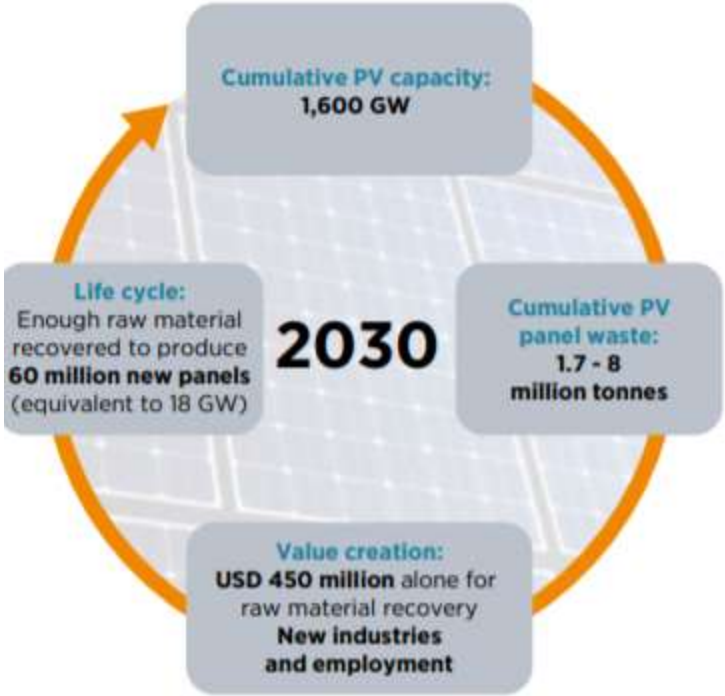
Wind turbine waste

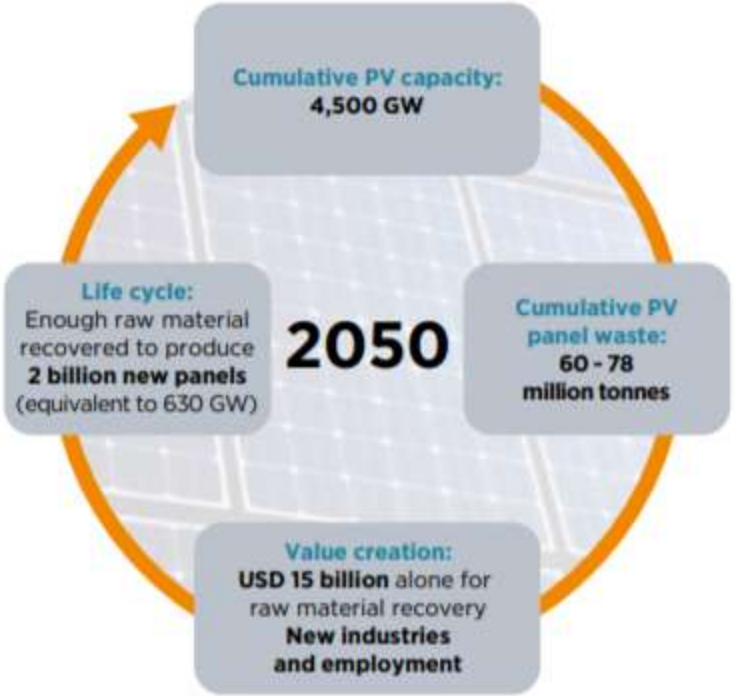




https://www.irena.org/publications/2016/Jun/End-of-life-management-Solar-Photovoltaic-Panels
https://www.researchgate.net/publication/303239488_A_cautionary_approach_in_transitioning_to_%27green%27_energy_technologies_and_practices_is_required/figures?lo=1

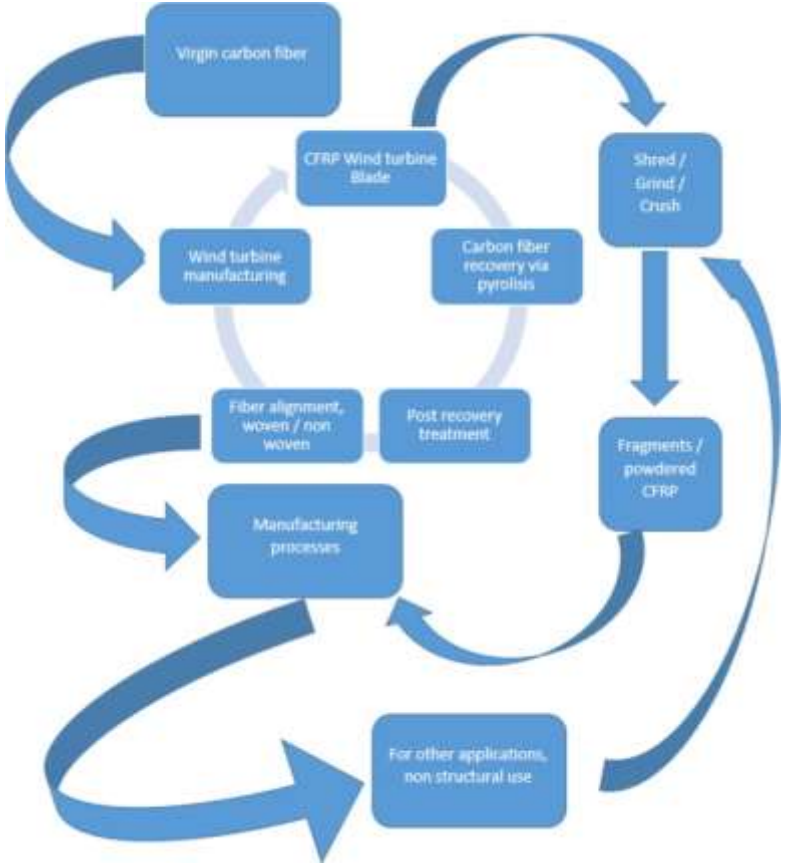
Potential value creation from solar panel waste management





https://www.irena.org/-/media/Files/IRENA/Agency/Publication/2016/IRENA_IEAPVPS_End-of-Life_Solar_PV_Panels_2016.pdf

Value creation from wind turbine blade waste management



https://www.sciencedirect.com/science/article/pii/S0048969719350466

Solution???

https://hub.beesmart.city/en/strategy/the-circular-economy-and-smart-city-solutions

PLASTIC: SEA TO SOURCE

Researching solutions to prevent plastic from reaching the ocean

MEET THE EXPEDITION TEAM GET INVOLVED

A GLOBAL CHALLENGE


PAKISTAN
CHINA
NEPAL
BHUTAN
BANGLADESH
INDIA
Harsil
Uttarkashi
Rishikesh
Anupshahr
Kannauj
Varanasi
Patna
Sahibganj
Rajbari
Chandpur
Bhola
Saharanpur
Meerut
Moradabad
Delhi
New Delhi
Aligarh
Agra
Jaipur
Lucknow
Gorakhpur
Kathmandu
Gwalior
Kanpur
Allahabad
Bhagalpur
Kota
Udaipur
Bhopal
Indore
Rajshahi
Dhanbad
Asansol
Barddhaman
Jessore
Bhatpara
Khulna
Kolkata
Medinipur
Haldia
Dhaka
GANGES RIVER BASIN
Sampling location
Ganges River main channel
Ganges River basin
0 mi
100
0 km
100


NATIONAL
GEOGRAPHIC
SOCIETY

High Level Panel for a Sustainable Ocean Economy

Catalysing bold, pragmatic ocean solutions in governance, technology and finance.

Creating a new relationship between humanity & ocean allowing us to Protect, Produce and Prosper.

Supporting the Sustainable Development Goals (SDGs) for a better future.

High Level Panel for a Sustainable Ocean Economy

Peter Thomson
UN SG's Special Envoy for the Ocean

Canada

Justin Trudeau
Prime Minister of Canada

Norway

Erna Solberg
Prime Minister of Norway

Portugal

António Costa
Prime Minister of Portugal

Japan

Shinzō Abe
Prime Minister of Japan

Jamaica

Andrew Holness
Prime Minister of Jamaica

Mexico

Andrés López Obrador
President of Mexico

Ghana

Nana Akufo-Addo
President of Ghana

Kenya

Uhuru Kenyatta
President of Kenya

Indonesia

Joko Widodo
President of Indonesia

Palau

Tommy Remengesau, Jr
President of Palau

Namibia

Hage Gottfried Geingob
President of Namibia

Fiji

Frank Bainimarama
Prime Minister of Fiji

Australia

Scott Morrison
Prime Minister of Australia

Chile

Sebastián Piñera
President of Chile

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A SUSTAINABLE
OCEAN ECONOMY


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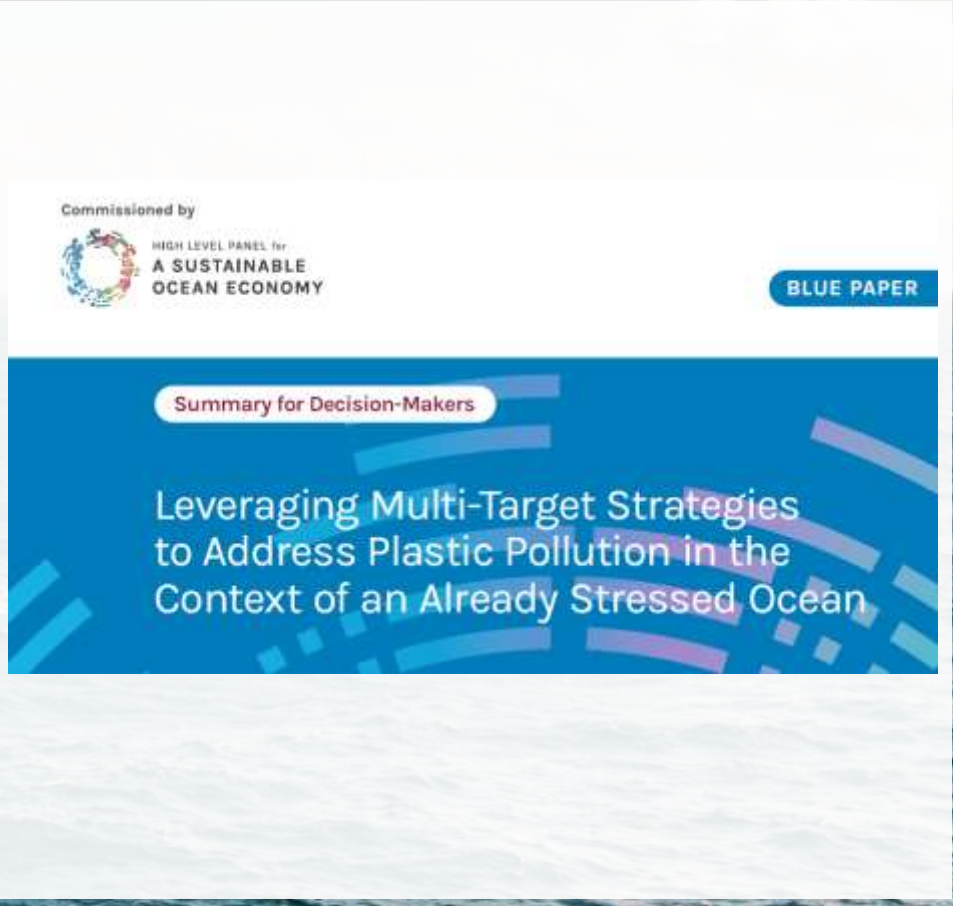
BLUE PAPER
Leveraging Multi-Target Strategies to Address Plastic Pollution in the Context of an Already Stressed Ocean
LEAD AUTHORS
Jenna Jambeck, Ellie Moss and Brajesh Dubey
CONTRIBUTORS
Zainal Arifin, Linda Godfrey, Britta Denise Hardesty, I. Gede Hendrawan, To Thi Hien, Liu Jungus, Marty Matlock, Sabine Pahl, Karen Raubenheimer, Martin Thiel, Richard Thompson and Lucy Woodall
oceanpanel.org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Professor, University of Georgia, USA

Lead Author

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Lead Author

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Liu Junguo	Professor, Southern University of Science and Technology, China
Marty Matlock	Executive Director, University of Arkansas Resiliency Center, University of Arkansas, United States
Sabine Pahl	Professor, University of Plymouth, United Kingdom
Karen Raubenheimer	Lecturer, University of Wollongong, Australia
Martin Thiel	Professor, Catholic University of the North, Chile
Richard Thompson	Professor, University of Plymouth, United Kingdom
Lucy Woodall	Senior research fellow, University of Oxford, and Principal scientist, Nekton, United Kingdom

Key Numbers

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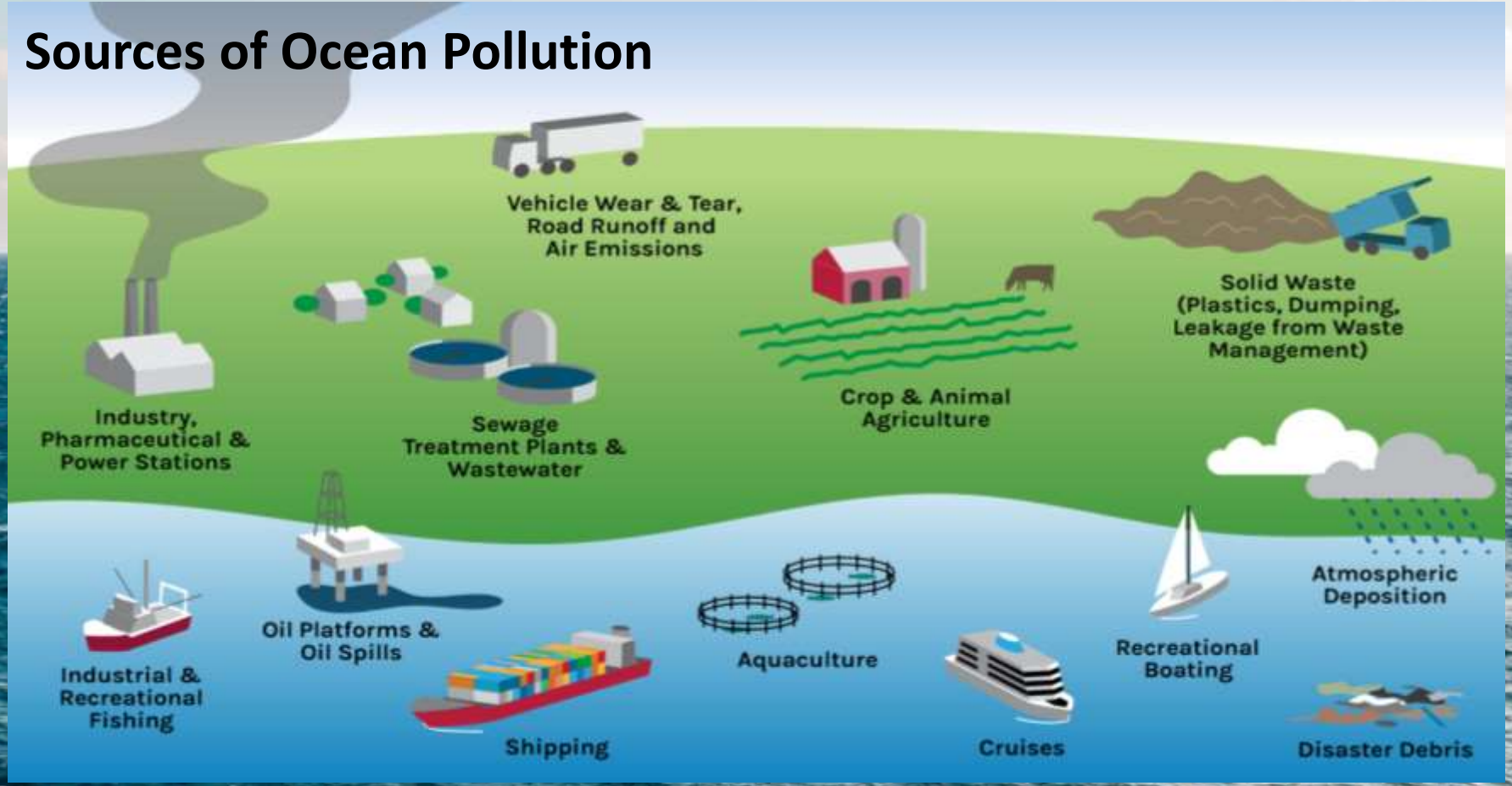
1.9 million microplastics per square meter on the ocean floor

Sources of Ocean Pollution



HIGH LEVEL PANEL for A SUSTAINABLE OCEAN ECONOMY

Plastic as a Key to Addressing Ocean Pollution, May 2020

Sectors

- Municipal

(coastal or near rivers)

- Agricultural and Aquacultural
- Industrial
- Maritime

Image Credits: Jenna Jambeck

Pollutants

- Microplastics (<5 millimetres [mm])
- Macroplastics (>5 mm)
- Other solid waste
- Pesticides
- Nutrients (Nitrogen, Phosphorus)
- Antibiotics, parasiticides, other pharmaceuticals
- Heavy metals
- Industrial chemicals and persistent organic pollutants
- Oil and gas

Image Credit: Jenna Jambeck

Impacts

Ocean

- Species' ingestion of and entanglement in plastic
- Transport of chemicals and invasive species from plastic
- "Ghost" fishing
- Eutrophication and hypoxia
- Biomagnification of chemicals

Health

- Reproductive, developmental, neurologic, endocrine and immunologic adverse health effects from chemicals
- Acute or chronic toxicity
- Increased exposure to pathogens and mosquito-borne diseases

Economy

- Impaired productivity of fisheries
- Loss of seafood supply from contamination
- Lost value of resources wasted rather than used in circular economy
- Reduced tourism and recreation in costal areas

Solutions to Stop Ocean Pollutants and Plastics

1. Improve wastewater treatment
2. Improve stormwater management
3. Adopt green chemistry practices and new materials
4. Practice radical resource efficiency
5. Recover and recycle
6. Improve coastal zones
7. Build local systems for safe food and water

HIGH LEVEL PANEL for
A SUSTAINABLE
OCEAN ECONOMY

Plastic as a Key to Addressing Ocean Pollution, May 2020

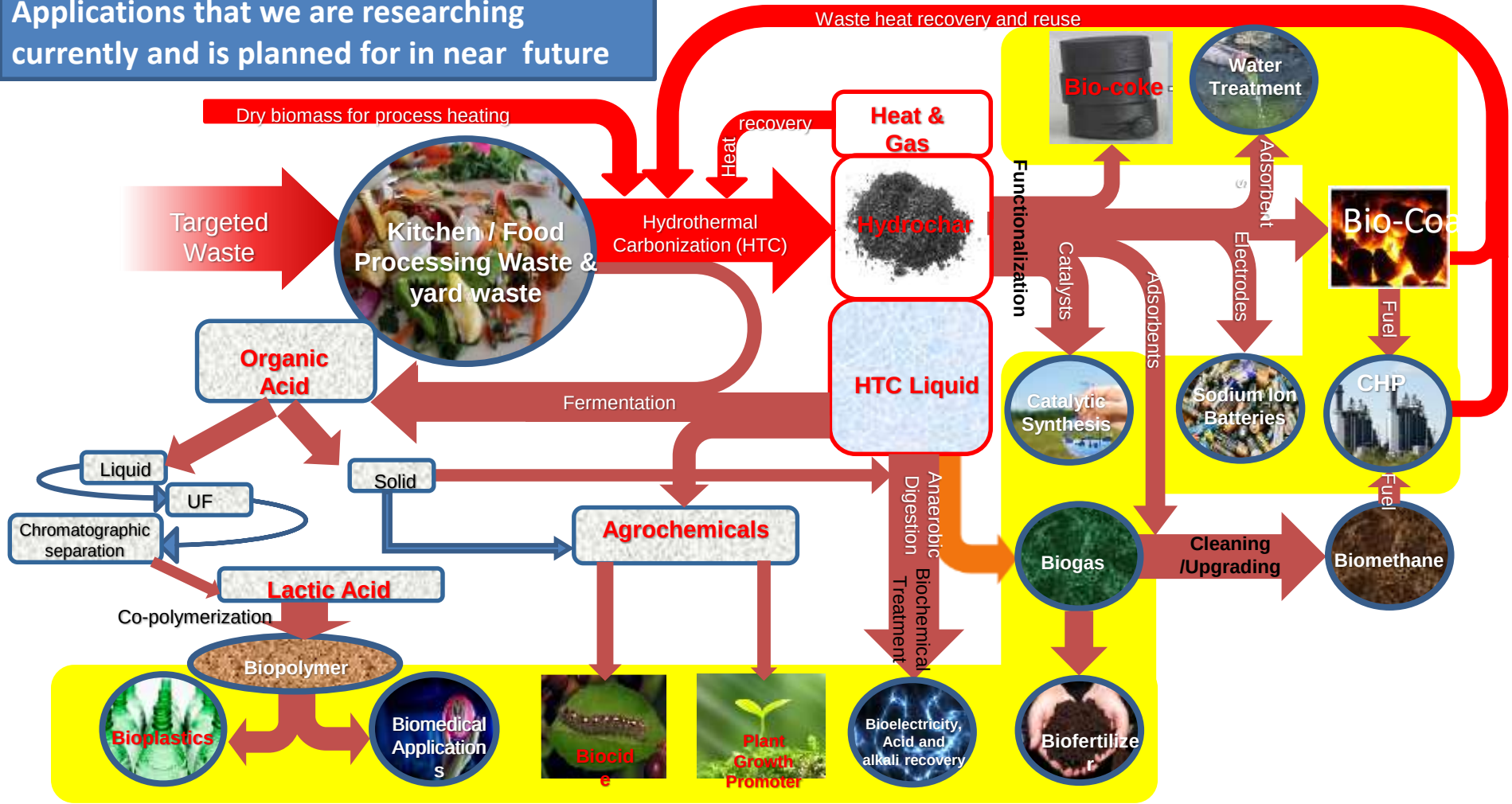
Summary of Interventions and Pollutants Addressed across Sectors and SDGs

	(1) IMPROVE WASTEWATER MANAGEMENT	(2) IMPROVE STORMWATER MANAGEMENT	(3) ADOPT GREEN CHEMISTRY PRACTICES AND NEW MATERIALS	(4) PRACTICE RADICAL RESOURCE EFFICIENCY	(5) RECOVER AND RECYCLE	(6) IMPROVE COASTAL ZONES	(7) BUILD LOCAL SYSTEMS FOR SAFE FOOD AND WATER
SDGS	6.2, 6.3	NONE	3.9, 12.4	8.3, 8.8, 11.6, 12.2, 12.5	8.3, 8.8, 11.6, 12.2, 12.5	NONE	6.1, 6.8, 2.1, 2.3
Microplastics	**M**	**M**	**M, A**	**M, A, I, Mar**	**M, A, I, Mar**	**M, Mar**	**M, A**
Macroplastics	**M**	**M**	**M, A, Mar**	**M, A, I, Mar**	**M, A, Mar**	**M, Mar**	**M, A**
Other solid waste	**M**	**M**		**M**	**M, A, Mar**	**M, Mar**	**M, A**
Pesticides		**A**	**M, A**	**M, A**			**A**
Nutrients (N, P)	**M, A**	**A**		**M, A**	**M, A**	**A**	**M, A**
Antibiotics, parasiticides, other pharma-ceuticals	**M, I**	**A**				**A**	**A**
Heavy metals	**M, I**	**M, A, I**	**M, A, I, Mar**			**A, I, Mar**	**A**
Industrial chemicals and POPs	**M, I**	**M, A**	**M, A, I, Mar**		**I**	**I**	
Oil and gas		**M, A, I**		**I, Mar**	**I**	**M, I, Mar**	

Note: Sectors are municipal (M), agricultural (A), industrial (I), maritime (Mar) Bold sectors are the primary scope of influence, non-bold are secondary; cells are shaded progressively darker as more sectors are impacted.

Source: Authors.

Applications that we are researching currently and is planned for in near future



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THANK YOU