Waste Management & Environmental Science

Chapter 15

What types of waste do you generate?

What happens to each of those waste types?

Andy Warhol

Just because people throw it out and don't have any use for it, doesn't mean it is garbage.

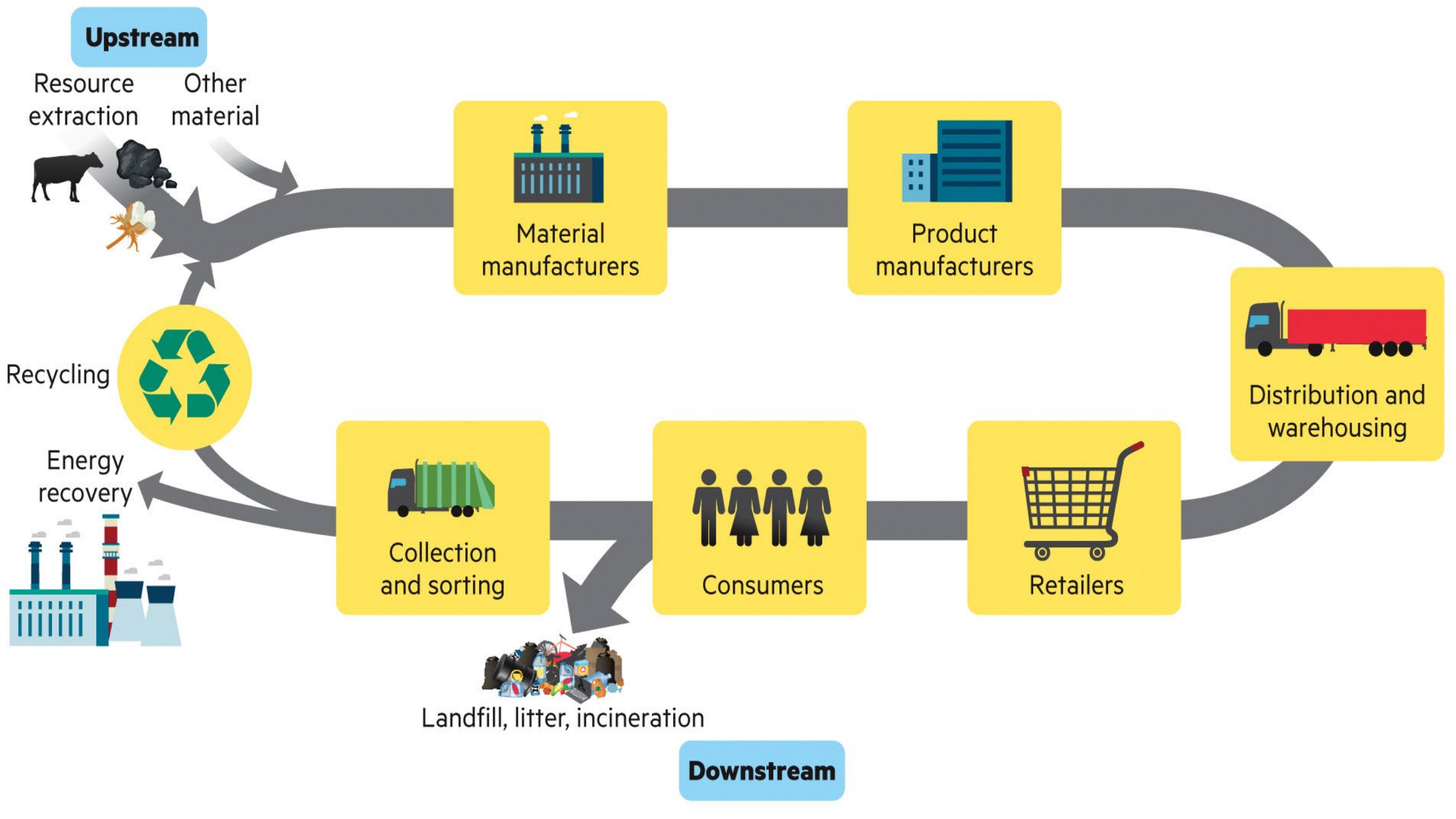
How could these words apply to waste…

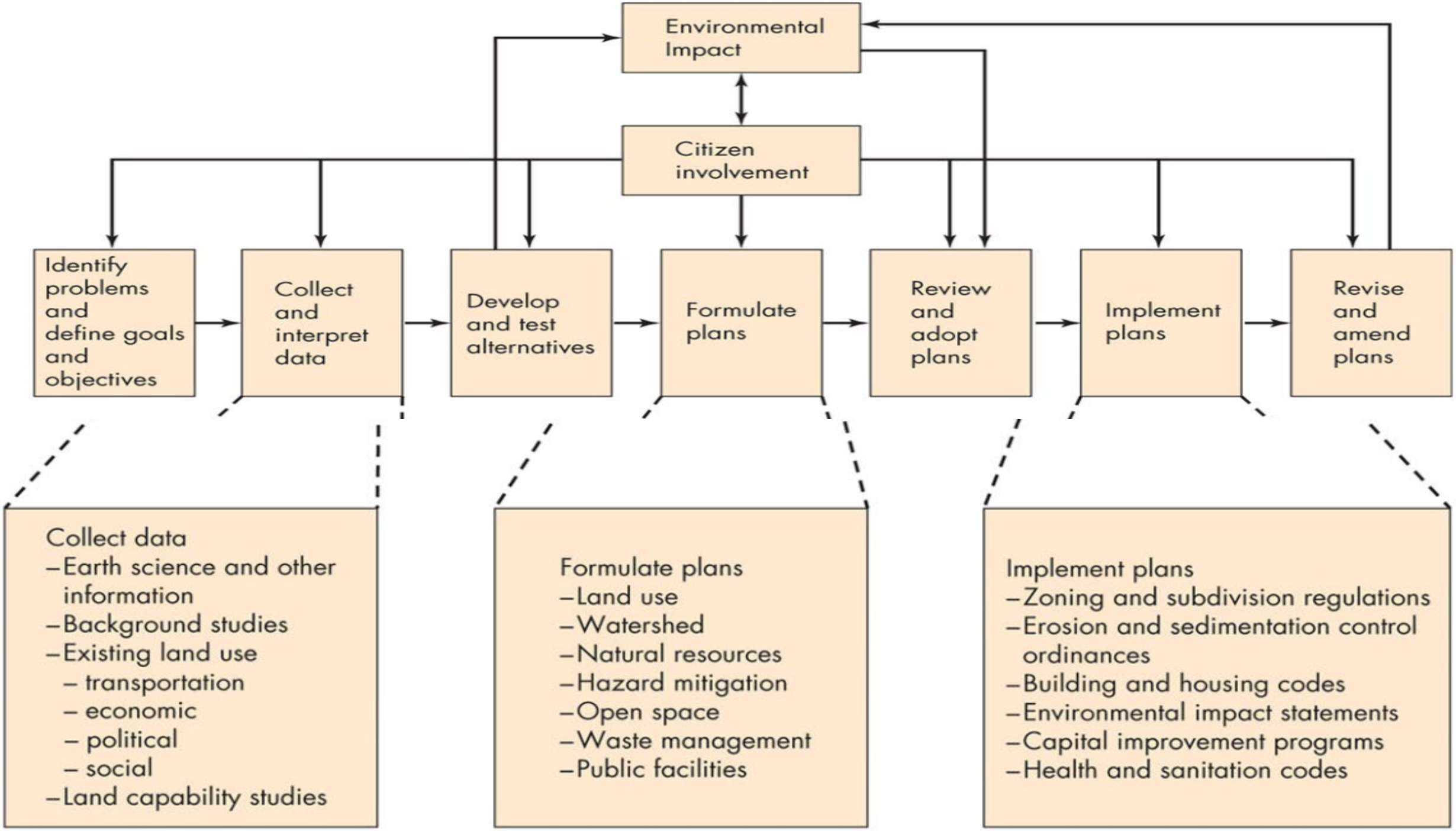
- Efficiency
- Conservation
- Zero


Savanah
THE MARTIAN CHRONICLES
RAY BRADBURY
COALATREE
I SUPPORT
NATIONAL PARKS
AMERICA'S BEST IDEA

Waste Ch. 15 Objectives:

A. Identify waste steams (up and down)
B. Learn about Waste management practices.
C. Explore recycling's advantages and disadvantages/limitations.
D. Characterize its environmental and socioeconomic implications
E. Discover reduce, reuse, conserve, create/Habits toward zero waste.

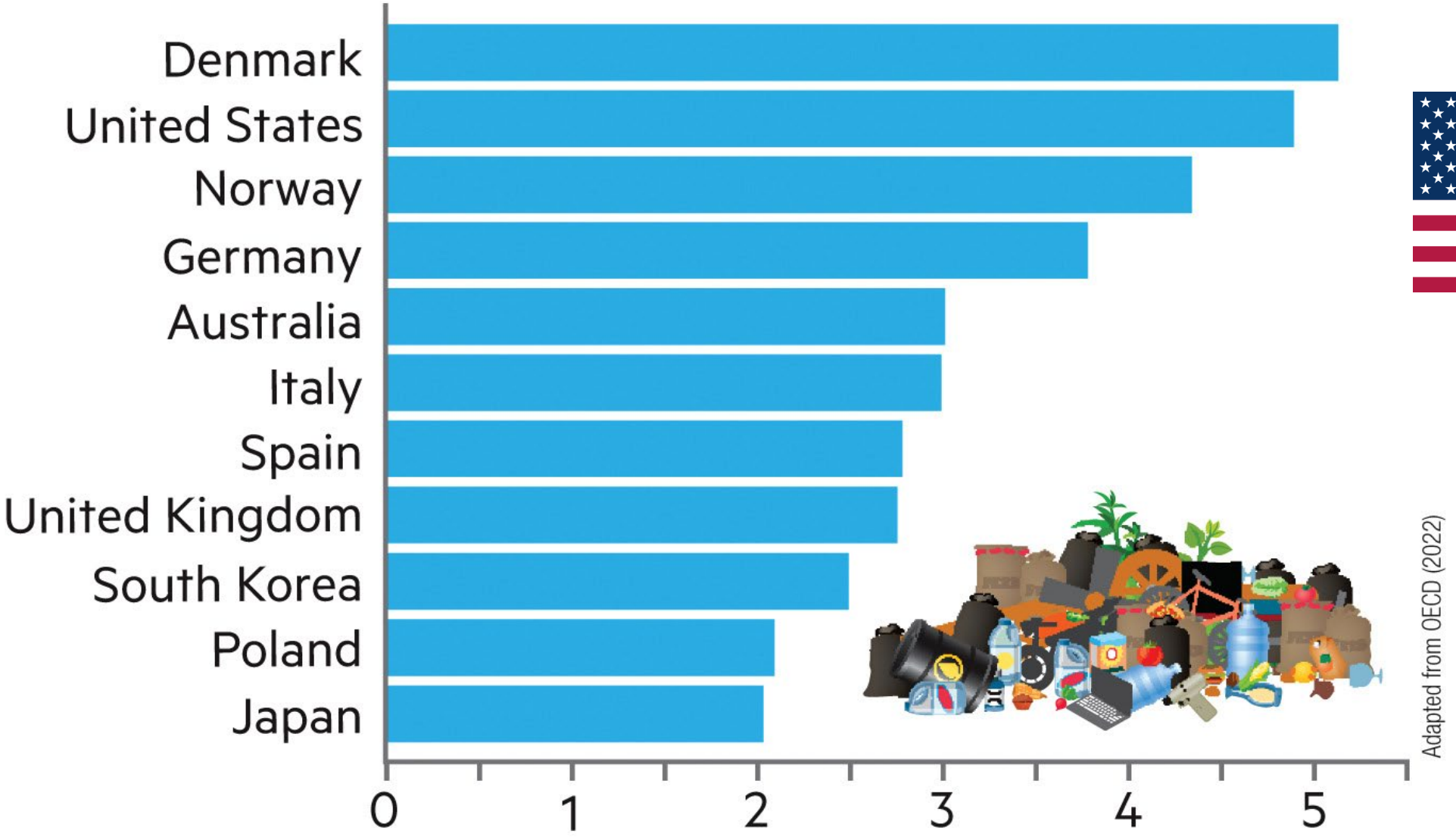

Upstream
Resource extraction
Other material
Material manufacturers
Product manufacturers
Distribution and warehousing
Recycling
Energy recovery
Collection and sorting
Consumers
Retailers
Landfill, litter, incineration
Downstream


Environmental Impact
Citizen involvement
Identify problems and define goals and objectives
Collect and interpret data
Develop and test alternatives
Formulate plans
Review and adopt plans
Implement plans
Revise and amend plans
Collect data
–Earth science and other information
–Background studies
–Existing land use
– transportation
– economic
– political
– social
–Land capability studies
Formulate plans
–Land use
–Watershed
–Natural resources
–Hazard mitigation
–Open space
–Waste management
–Public facilities
Implement plans
–Zoning and subdivision regulations
–Erosion and sedimentation control ordinances
–Building and housing codes
–Environmental impact statements
–Capital improvement programs
–Health and sanitation codes

MSW Generation Rates, 1960-2018

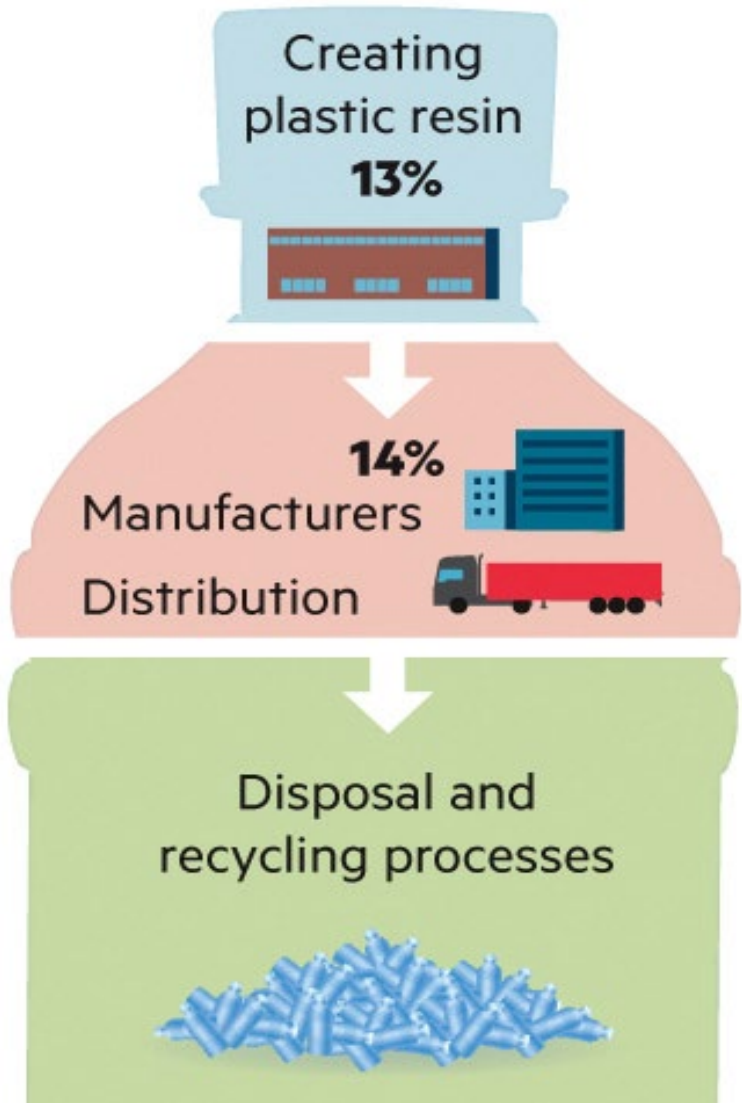
Adapted from US EPA (2018c)

Daily MSW Generation per Person for Selected Countries, 2018–2020



Adapted from OECD (2022)


Creating plastic resin
13%
14%
Manufacturers
Distribution
Disposal and recycling processes
73%
Other impacts include
Air pollution
Greenhouse gas emissions
Adapted from Franklin Associates (2007)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Disposal and recycling processes


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Other impacts include
Air pollution
Greenhouse gas emissions
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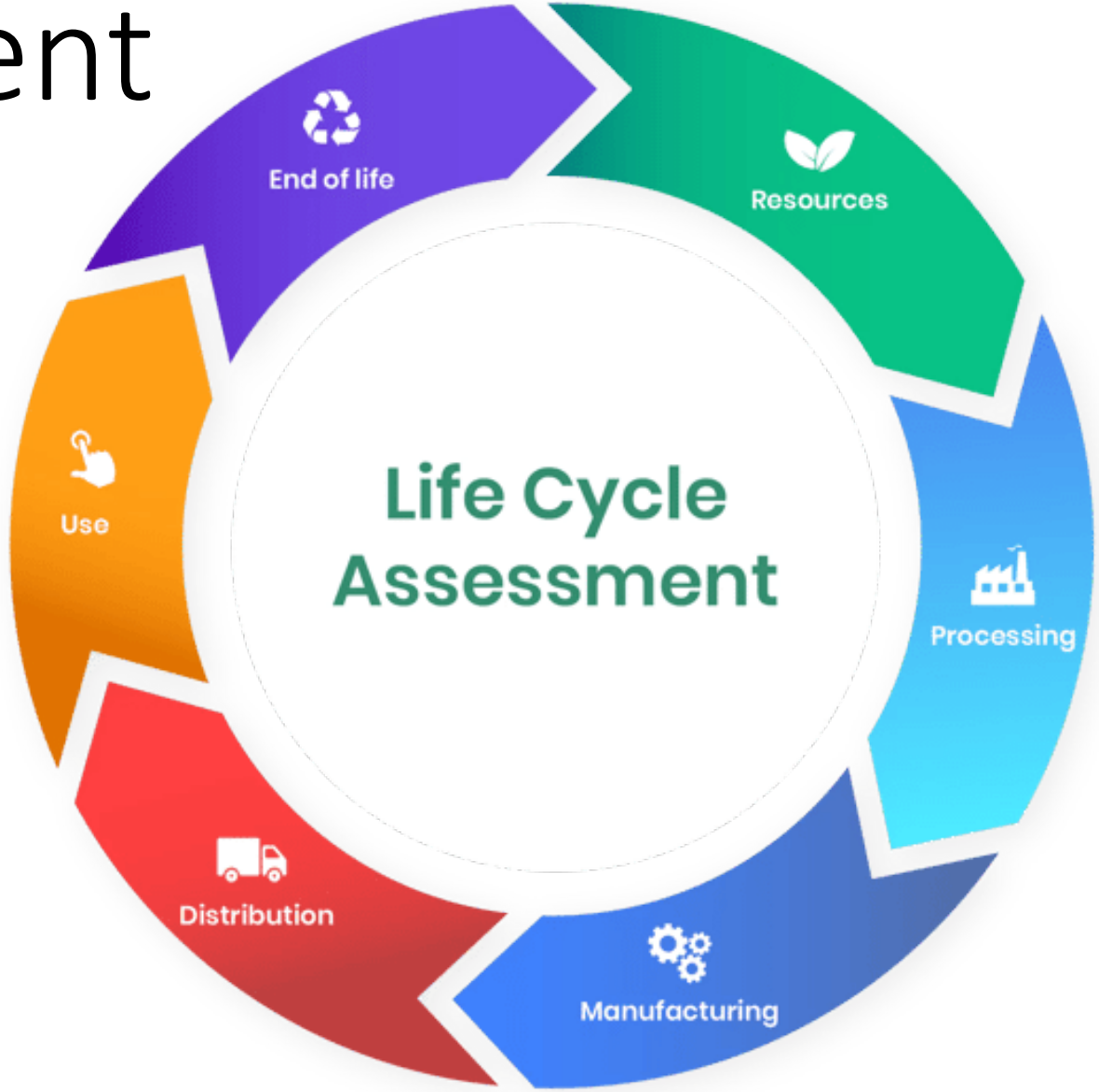
Solid waste

All discarded material in solid, liquid, semi-solid or gaseous form.

Life-Cycle Assessment

An evaluation of environmental impacts of every step involved in making, distributing, using, and disposing of a good or service.

True Cost Accounting

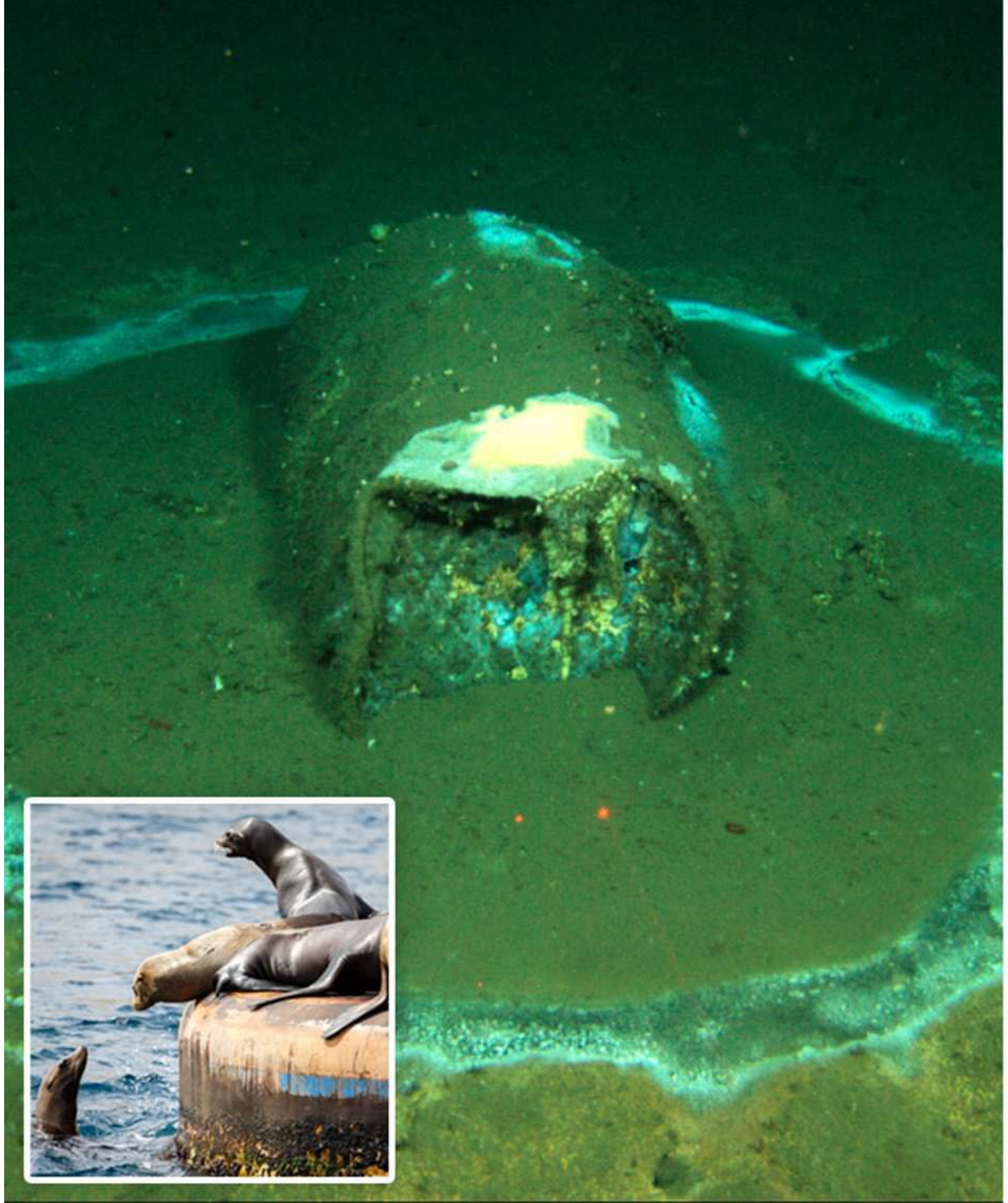


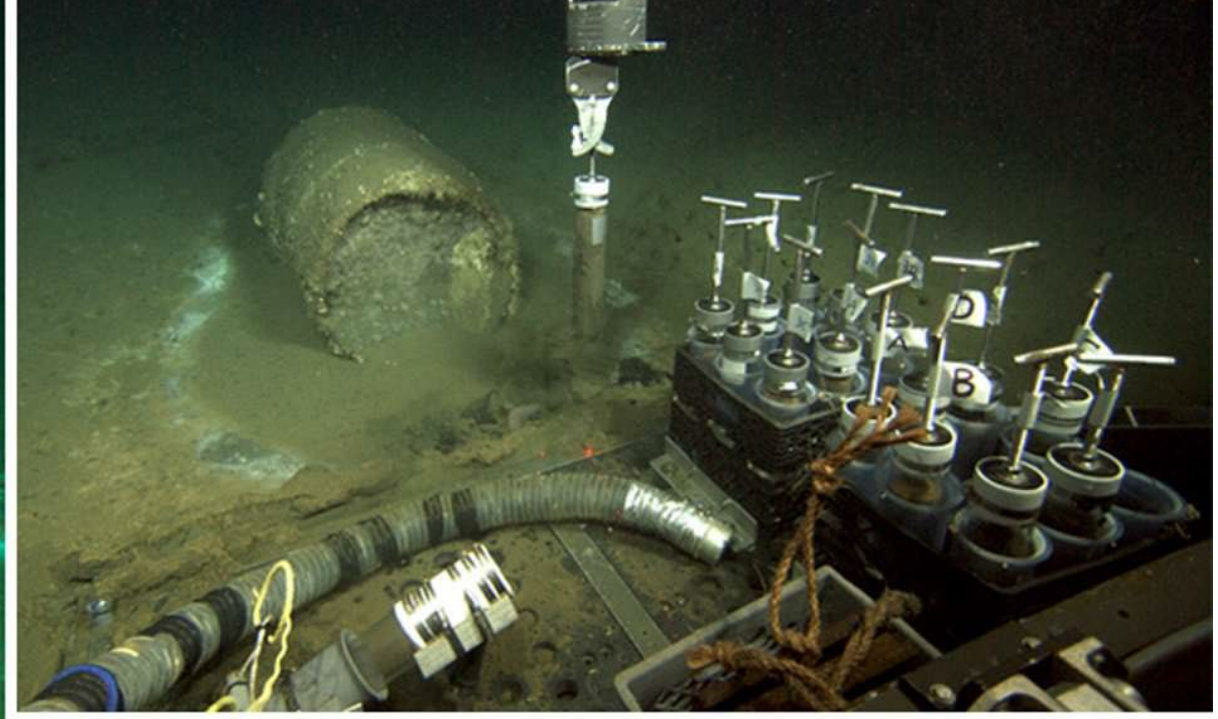
Ocean Dumping

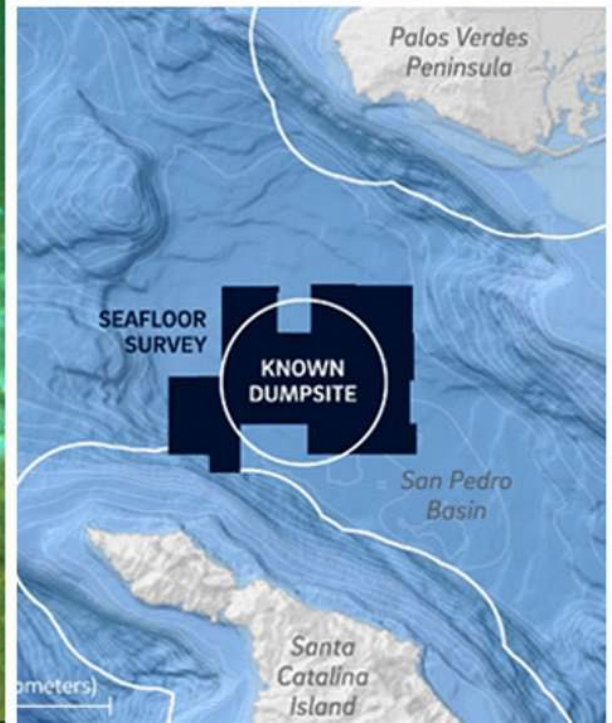
New York City

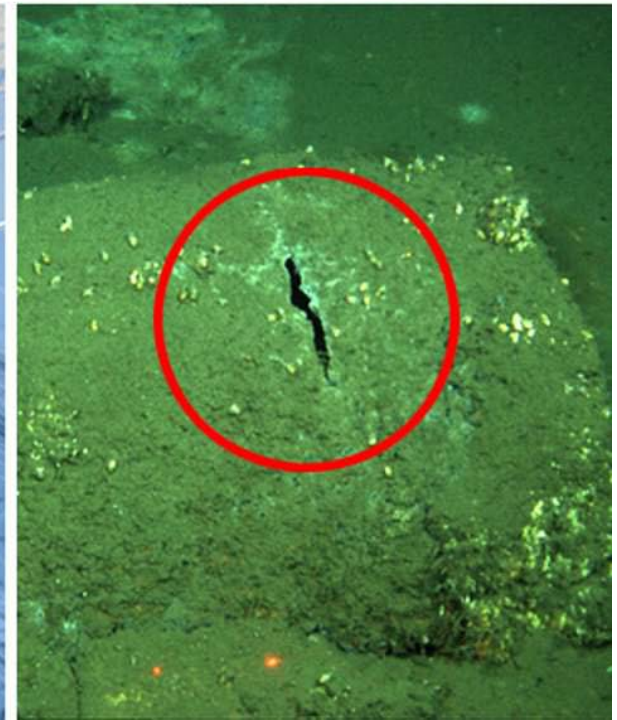
AP Photo/David Bookstaver


California
Santa Barbara
Los Angeles
Riverside
Montrose Chemical Corporation
Outfalls
Anacapa Island
San Miguel Island
Santa Rosa Island
Santa Cruz Island
Santa Barbara Island
Channel Islands
Santa Catalina Island
San Nicolas Island
San Clemente Island
California Current
S. California Countercurr
San Diego

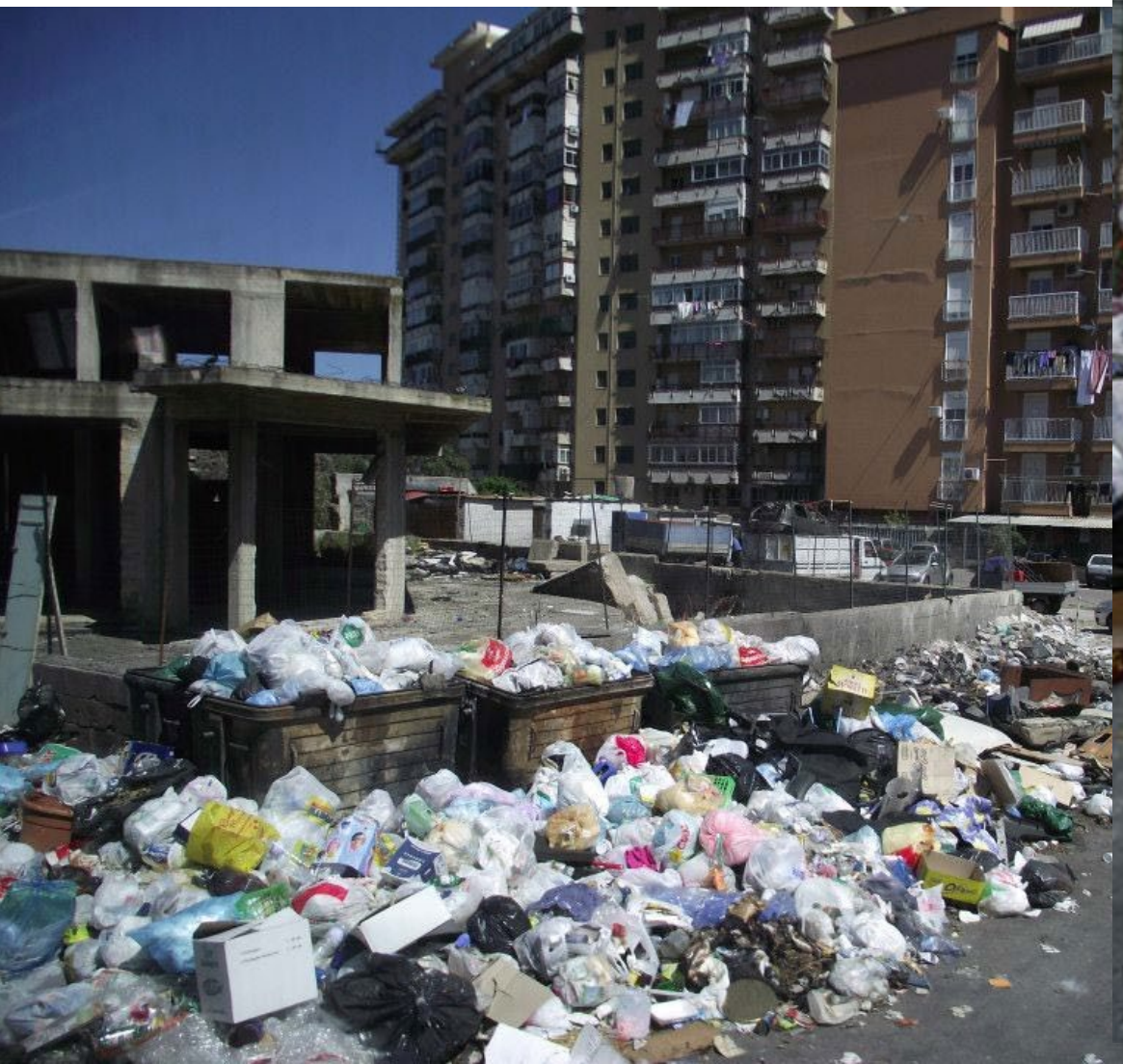




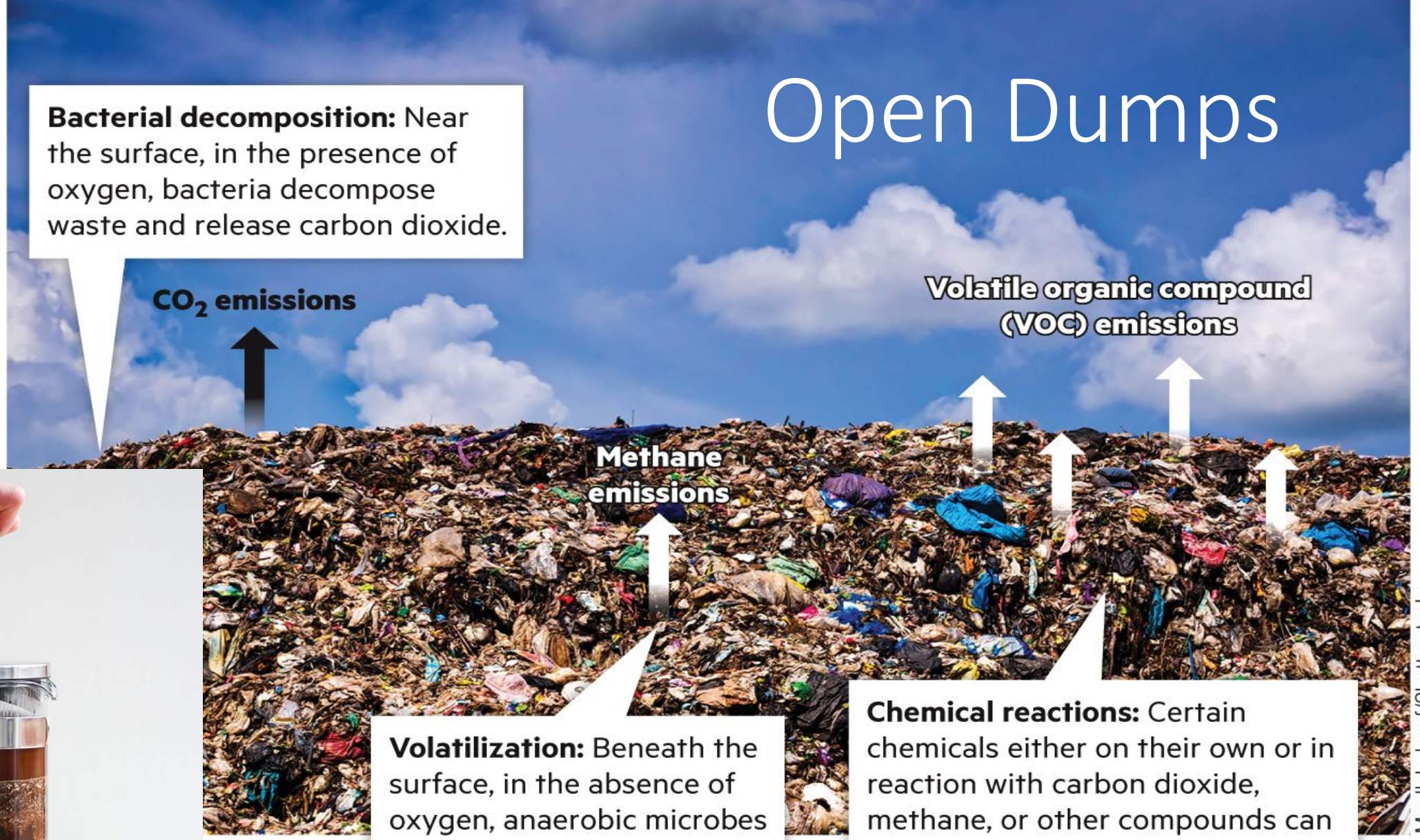

Palos Verdes
Peninsula
SEAFLOOR
SURVEY
KNOWN
DUMPSITE
San Pedro
Basin
Santa
Catalina
Island



Palermo, Sicily



Open Dumps



Muellek Josef/Shutterstock

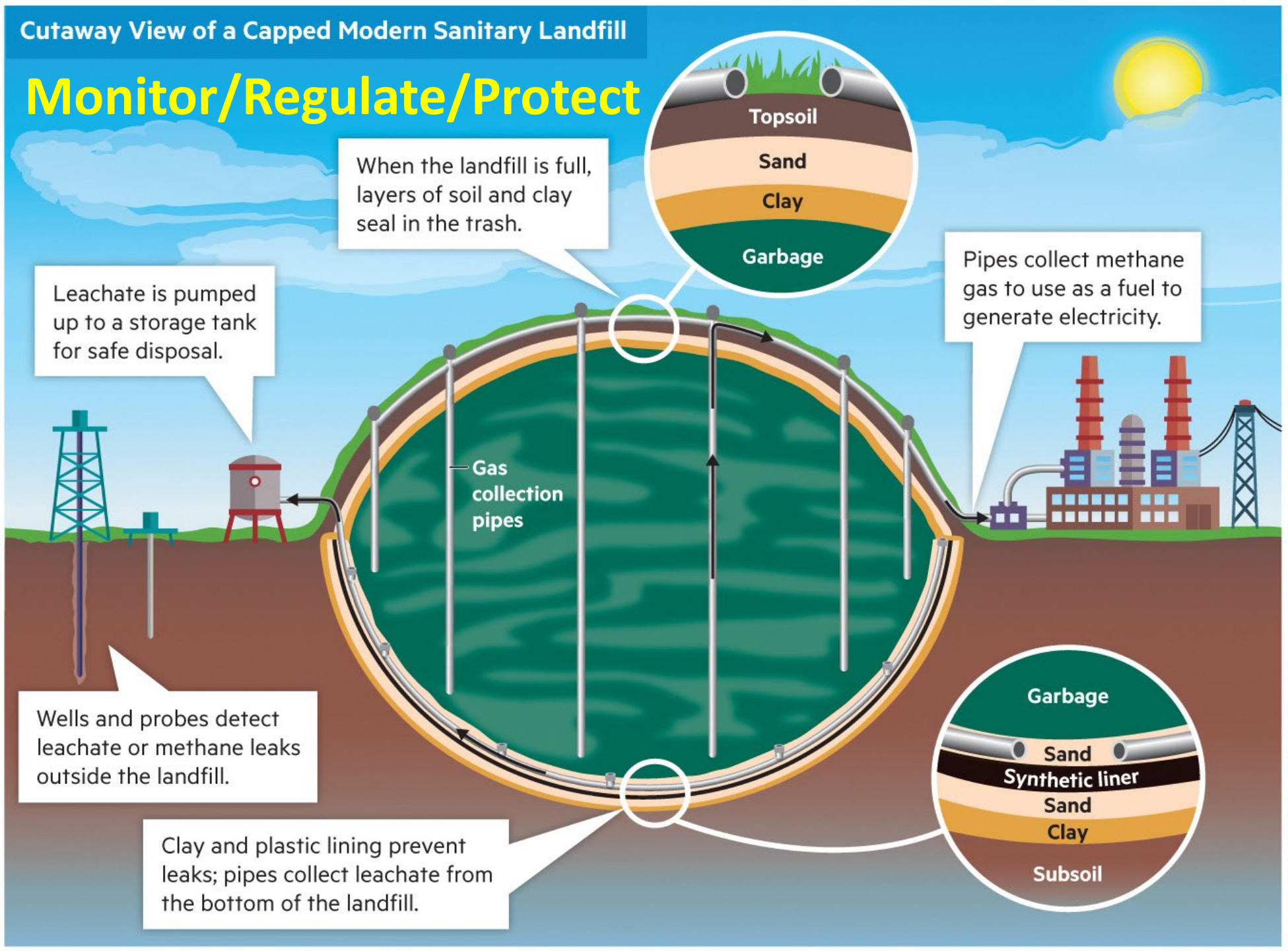
Leachate

Smokey Mountain Dump Philippines

National Housing
1993-1995
Slum – 30K people

1995-2017
Payatas Dump
Slum – 80K people
2000 – 200 deaths

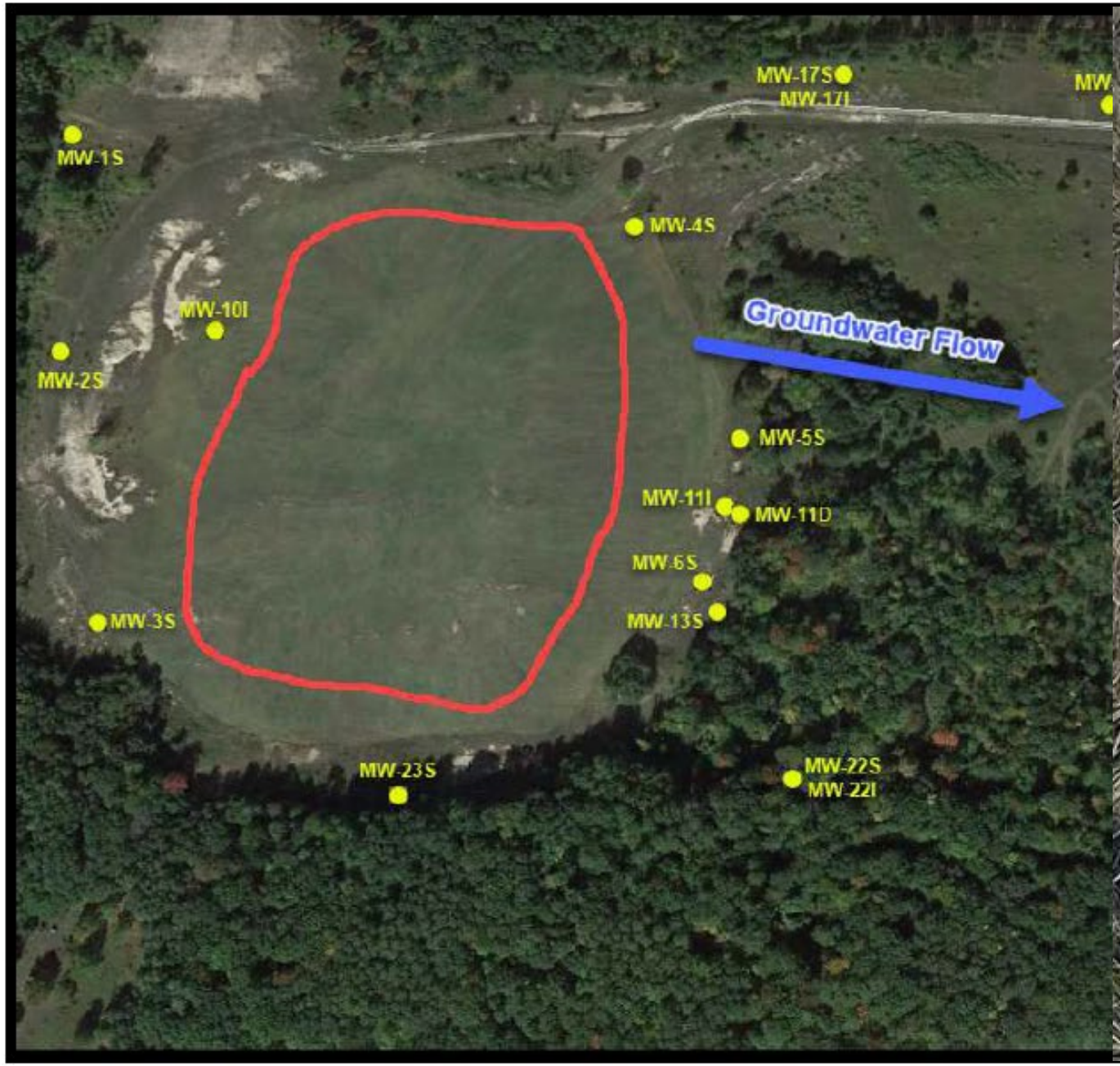
Peter Charlesworth/LightRocket via Getty Images



Cap

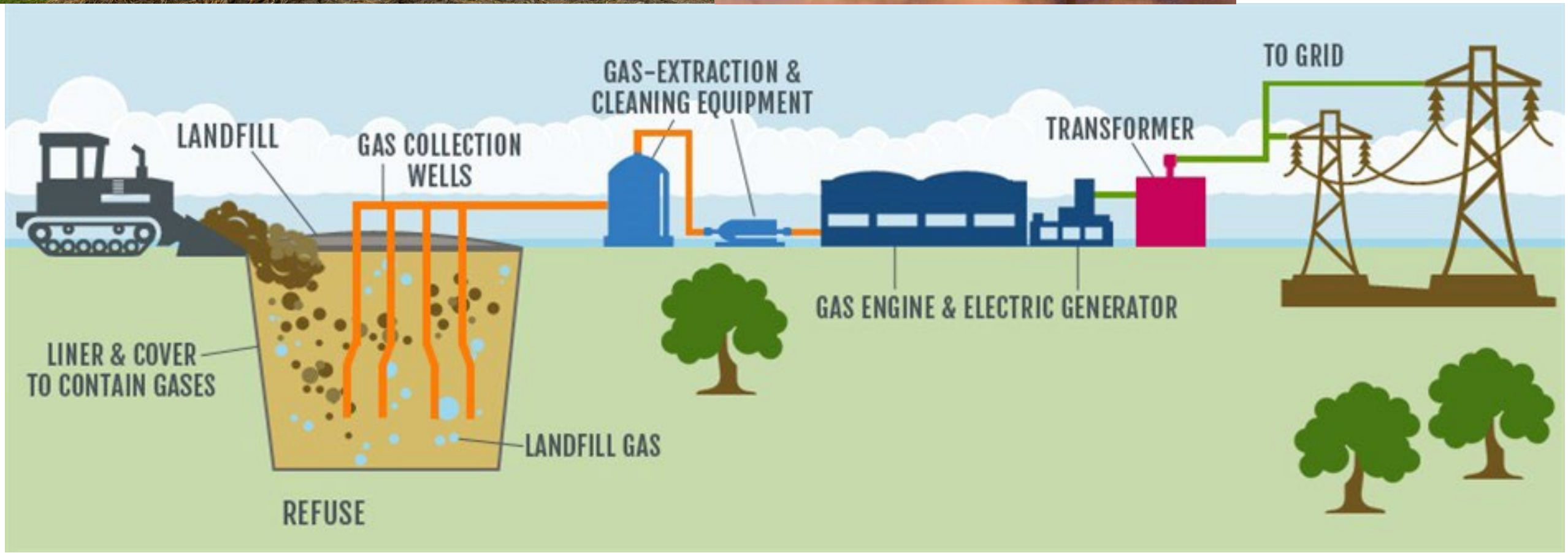
Isolated/Vented Interior

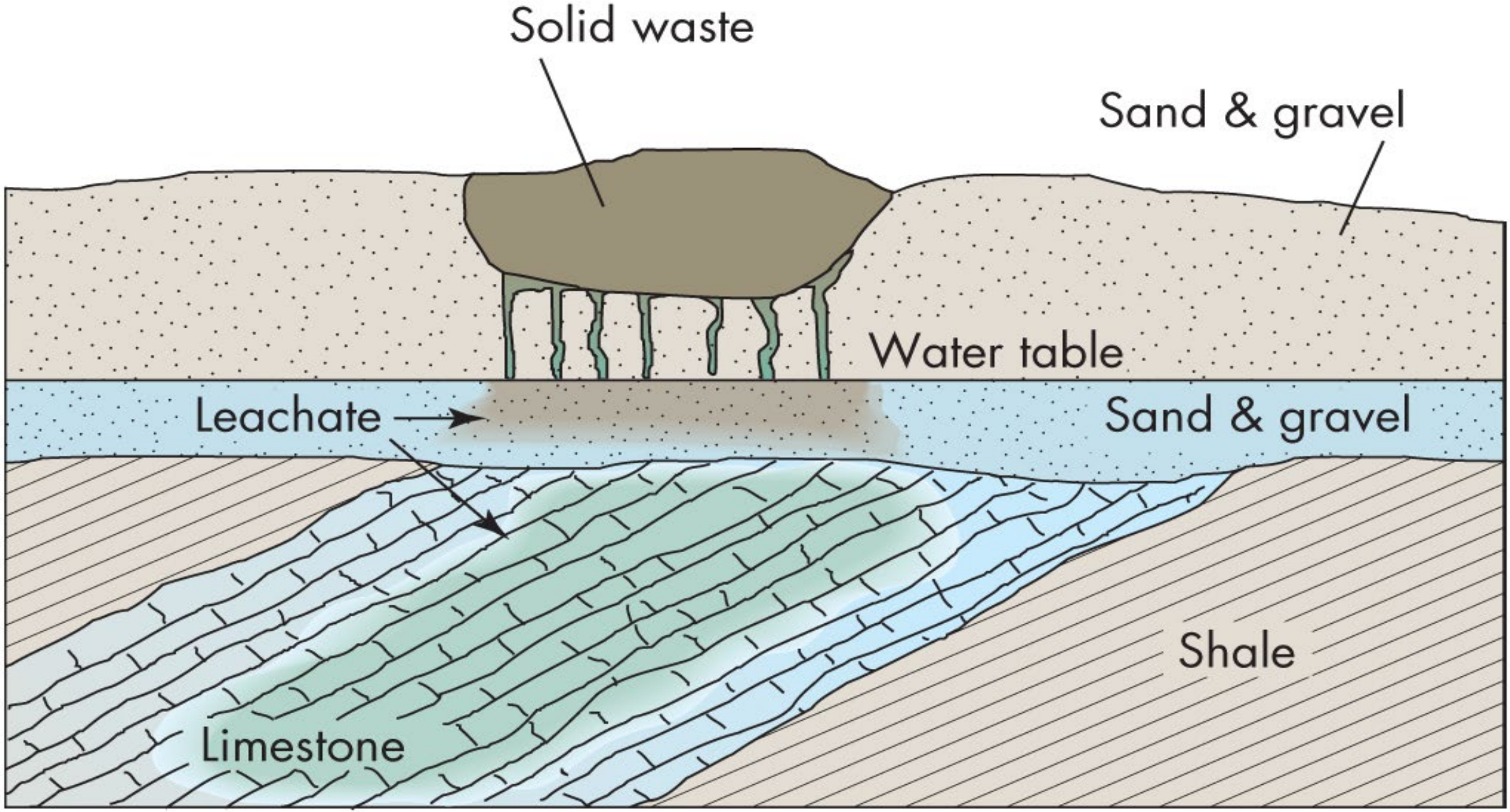
Protective Liner

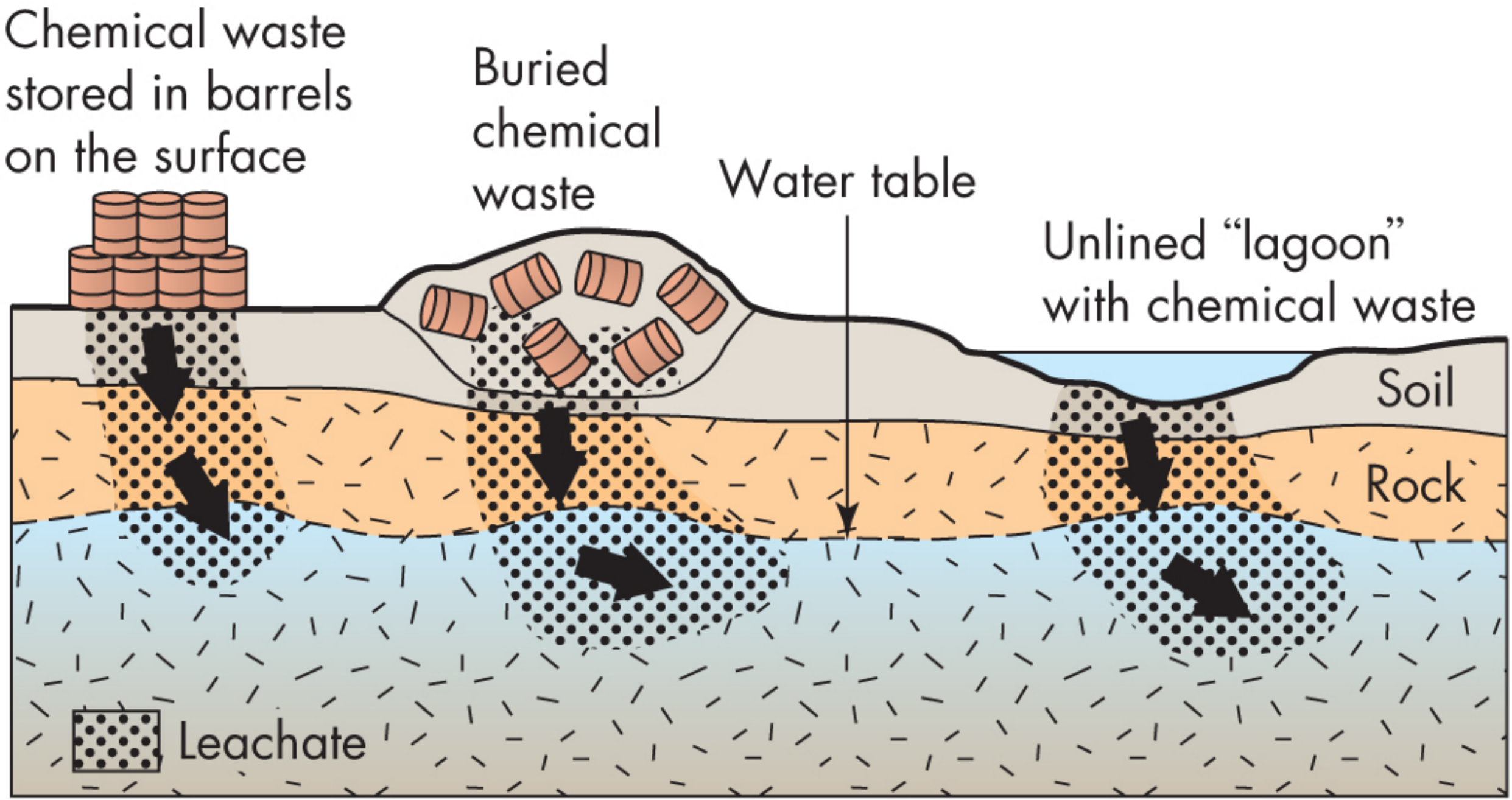


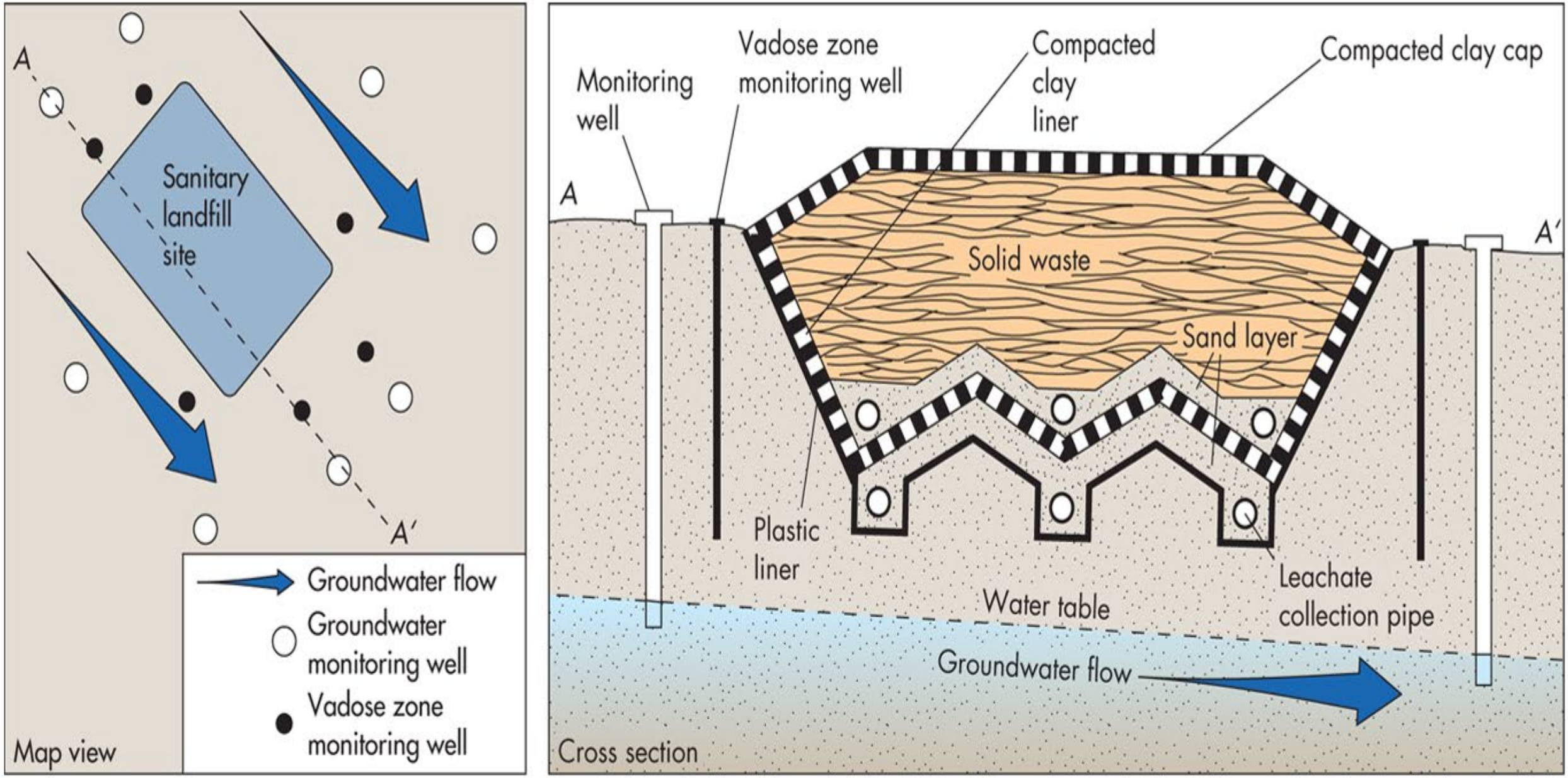
(sandstone or fractured limestone) groundwater

Methane Emissions




Solid waste
Sand & gravel
Water table
Leachate
Sand & gravel
Shale
Limestone


Chemical waste stored in barrels on the surface
Buried chemical waste
Water table
Unlined "lagoon" with chemical waste
Soil
Rock
Leachate


A
Sanitary landfill site
A′
Groundwater flow
Groundwater monitoring well
Vadose zone monitoring well
Map view
Monitoring well
Vadose zone monitoring well
Compacted clay liner
Compacted clay cap
A
A′
Solid waste
Sand layer
Plastic liner
Leachate collection pipe
Water table
Groundwater flow
Cross section

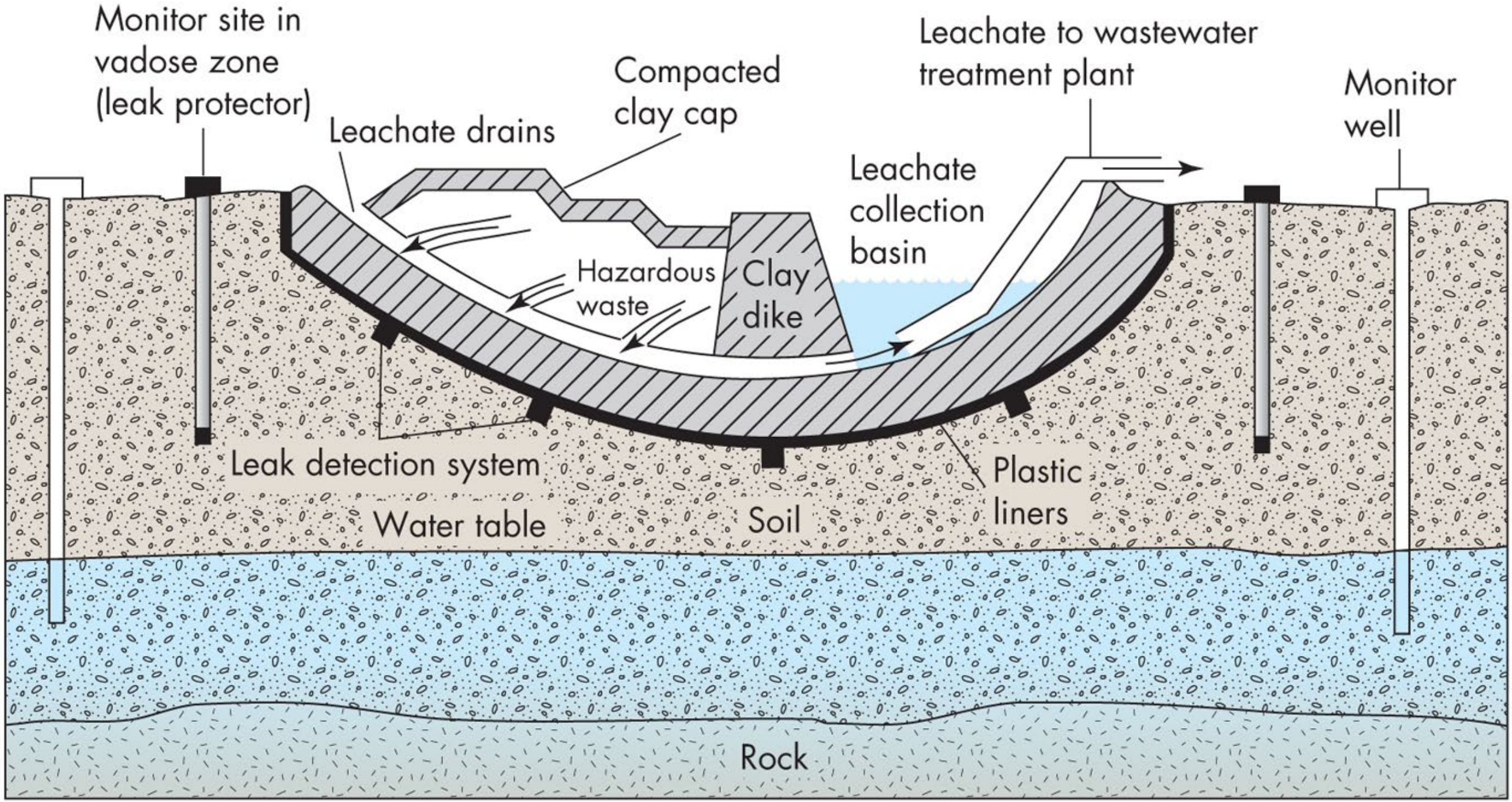
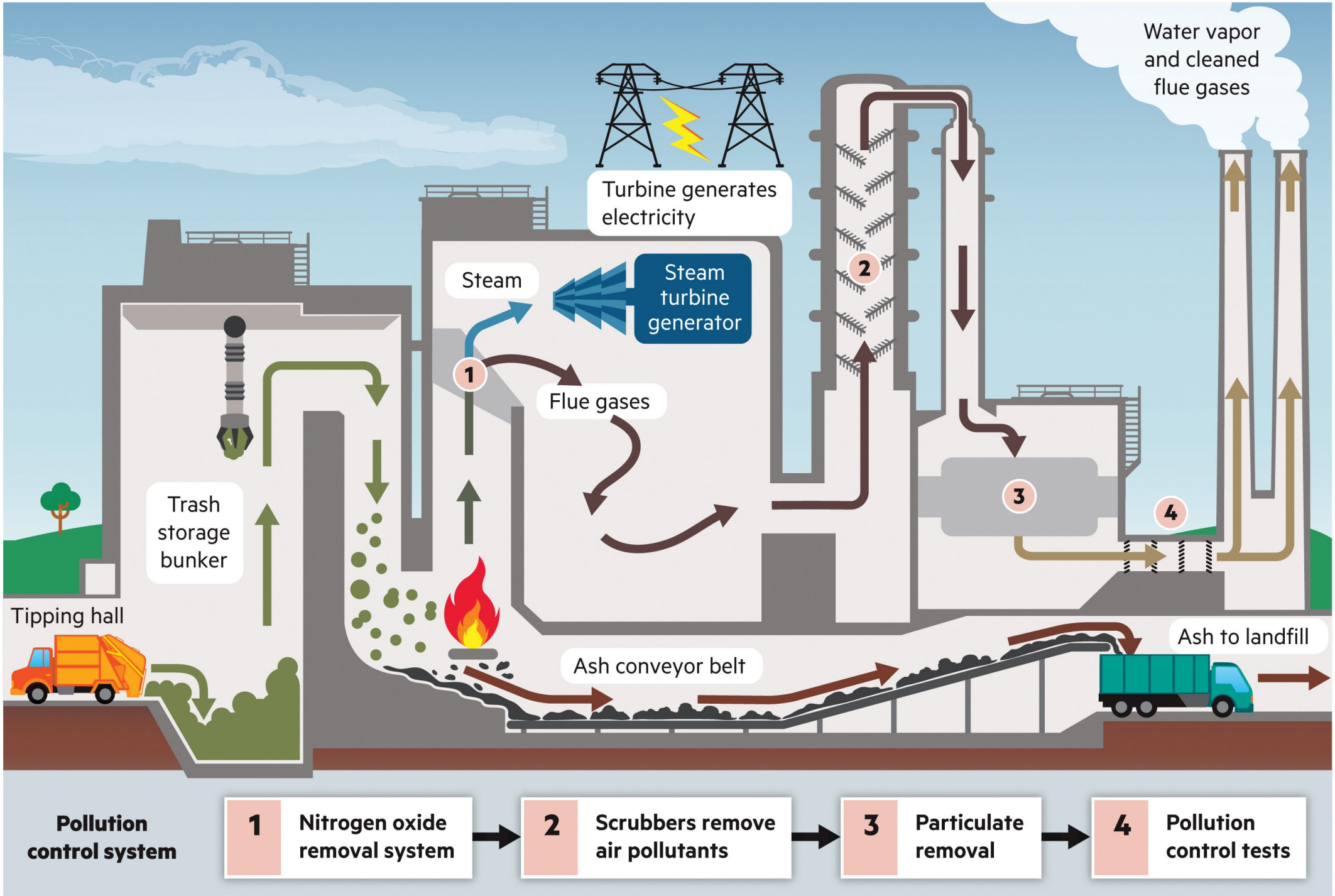

Monitor site in vadose zone (leak protector)
Leachate drains
Compacted clay cap
Leachate to wastewater treatment plant
Monitor well
Leachate collection basin
Hazardous waste
Clay dike
Leak detection system
Plastic liners
Water table
Soil
Rock

TABLE 15.1 Modern Waste Management Strategies

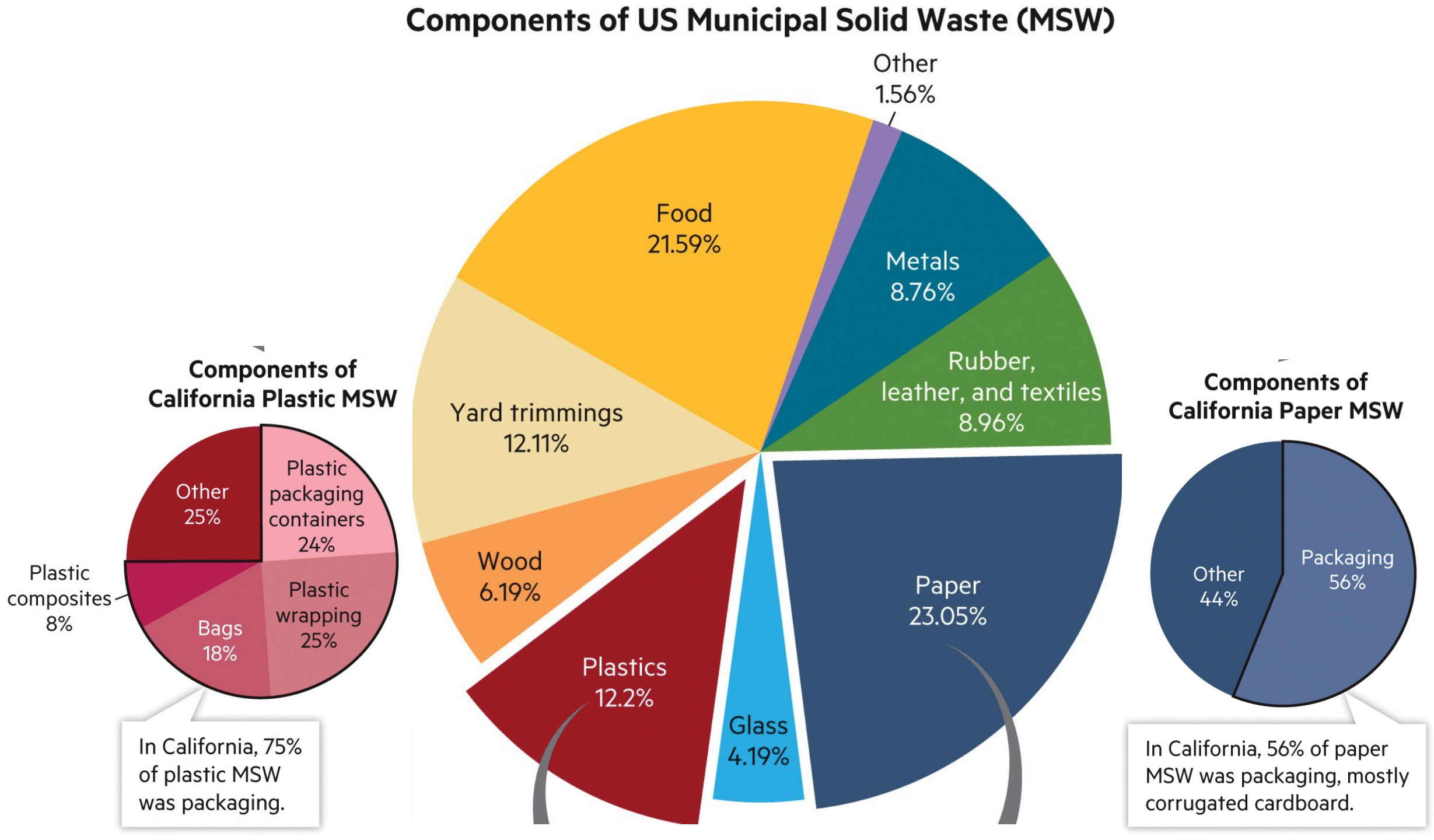
Waste Management Strategy	Benefits	Impacts
Isolation • Sanitary landfills • Geologic disposal • Containment buildings	Improvement over dumps Caps and liners prevent waste from escaping into the environment Some strategies allow waste to be moved and treated at a later date	Does not reduce the volume of waste Requires a large area of land to be converted for this use Caps and liners often leak Can produce the greenhouse gas methane from decomposition Risk of water pollution due to failure of caps and liners
Incineration	Reduces waste volume Does not require large areas of land Less risk of direct water pollution	Requires high energy inputs to attain extremely high temperature for combustion Produces a wide range of air pollution and greenhouse gases Harmful materials can remain in residual ash
Conversion	Waste-to-energy conversion leads to some benefit from disposal, such as electricity or heat Remediation technologies can remove certain toxins from the waste	Still uses landfills so has their associated challenges Requires precautions to prevent removed toxins from contaminating the environment

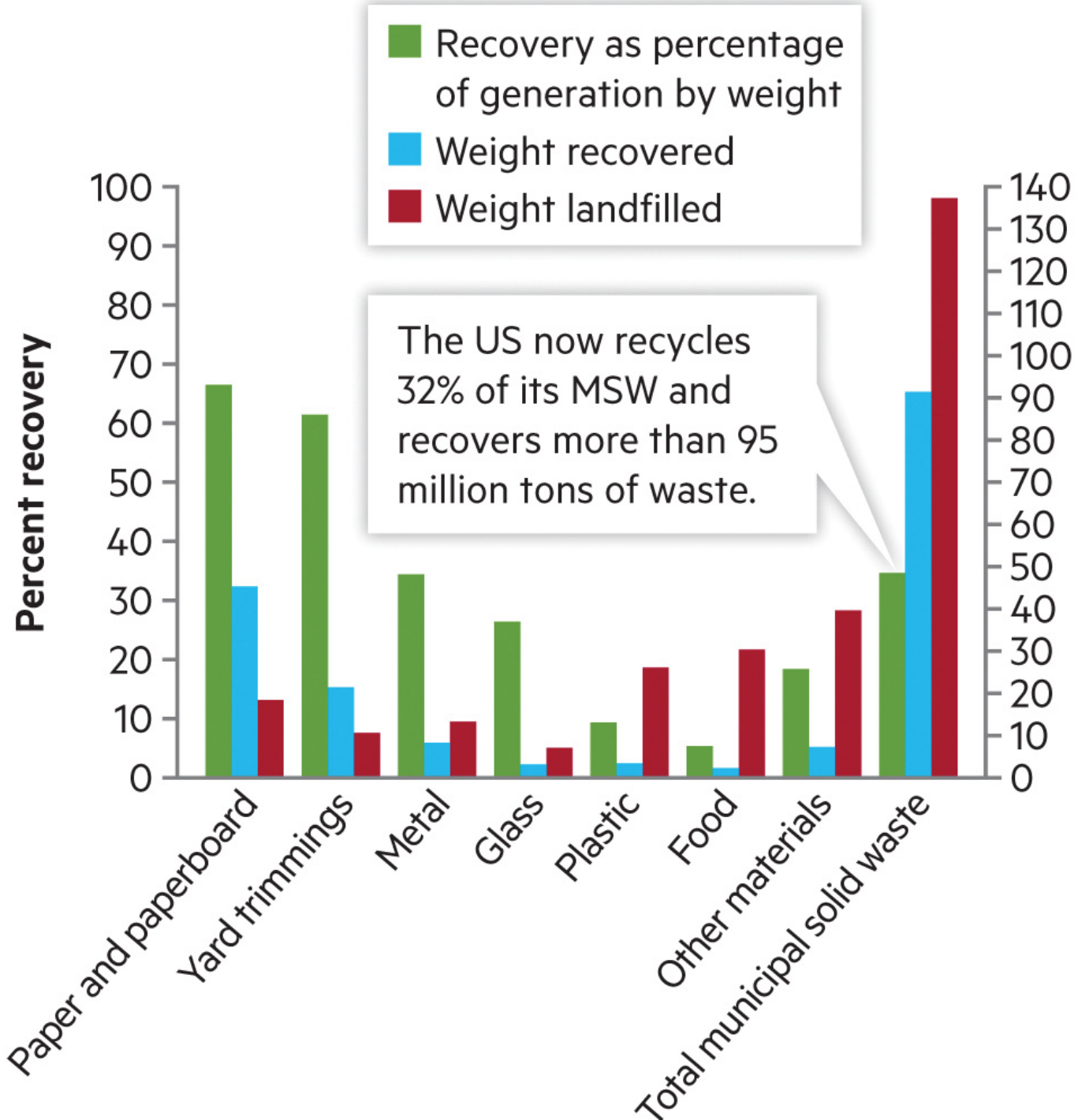

Water vapor and cleaned flue gases
Turbine generates electricity
Steam
Steam turbine generator
1
2
3
4
Flue gases
Trash storage bunker
Tipping hall
Ash conveyor belt
Ash to landfill
Pollution control system
1 Nitrogen oxide removal system
2 Scrubbers remove air pollutants
3 Particulate removal
4 Pollution control tests
Adapted from US EPA (2016)


BUSINESS
INSIDER
BIG BUSINESS


UNITED AIRLINES
UNITED AIRLINES
UNITED AIRLINES
UNITED AIRLINES
UNITED
UNITED AIRLINES
UNITED AIRLINES

300 to 500K miles , working on new system for 1,000,000


Components of US Municipal Solid Waste (MSW)
Other 1.56%
Food 21.59%
Metals 8.76%
Rubber, leather, and textiles 8.96%
Yard trimmings 12.11%
Wood 6.19%
Plastics 12.2%
Glass 4.19%
Paper 23.05%
Components of California Plastic MSW
Other 25%
Plastic packaging containers 24%
Plastic composites 8%
Bags 18%
Plastic wrapping 25%
In California, 75% of plastic MSW was packaging.
Components of California Paper MSW
Other 44%
Packaging 56%
In California, 56% of paper MSW was packaging, mostly corrugated cardboard.
Adapted from US EPA (2018a) and CalRecycle (2021



Plastic Resin Codes Chart. Reprinted by permission of Recycling Resource Systems, Inc. (RRS)

Recycling – Waste as a Resource

- Primary
  - Closed-loop
    - E.g. Al-cans into Al-cans, 60days
- Secondary
  - Open-Loop
    - E.g. Plastic Bottles into clothes or drain tiles

Savanah

Sustain

50% recycled plastic

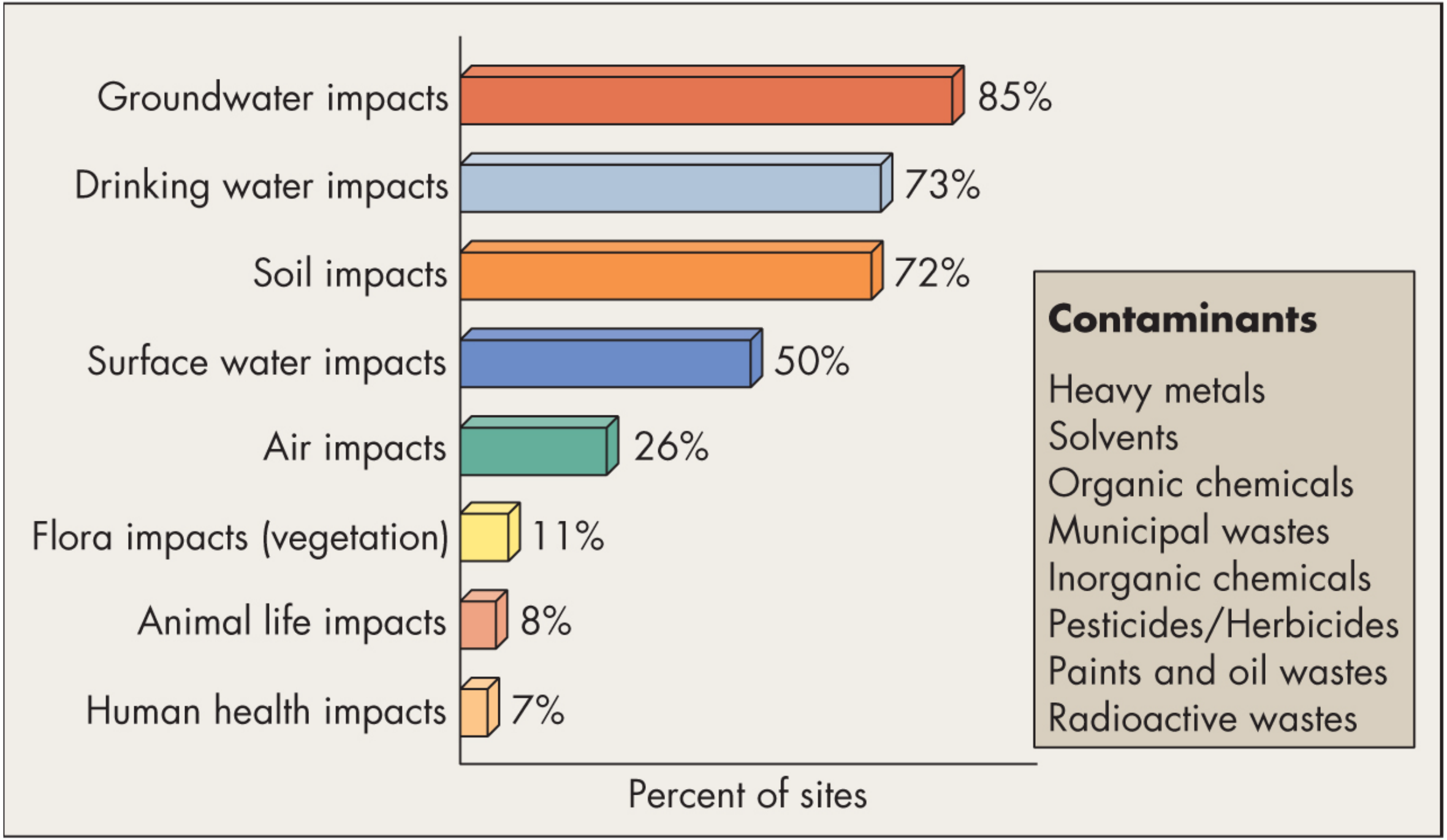
Reuse, Refurbish, Repurpose, Upcyle

EU: Right to Know – Right to Repair

- Extended Warranty for Repairs
- Right to Repair Outside Warranty
- Access to Spare Parts and Repair Information
- Transparency in Repair Costs
- Promotion of Repair Initiatives

Circular Economy Focus

A broader effort to promote a circular economy, where products are designed for durability, repairability, and reuse



Love Canal, New York

Savanah

Sustain

50% recycled plastic

Zero Waste

Important decisions

We live on a dynamic planet and must make careful decisions concerning where we choose to live and how we plan for sustainability.

Business as usual will not work for environment or humanity.

Risk management, Risk Aversion : Choices and Discussions