SOLID WASTE MANAGEMENT

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SOLID WASTE

Municipal solid waste, commonly known as trash or garbage (US), refuse or rubbish (UK) is a waste type consisting of everyday items we consume and discard.

It predominantly includes food wastes, yard wastes, containers and product packaging, and other miscellaneous inorganic wastes from residential, commercial, institutional, and industrial sources.

Examples of organic wastes are newspapers, clothing, food scrapes, boxes, disposable tableware, office and classroom paper, furniture, wood pallets, rubber tires, and canteen or cafeteria wastes.

Municipal solid waste does not include industrial wastes, agricultural wastes, and sewage sludge.

The collection is performed by the municipality within a given area. They are in either solid or semisolid form.

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SOLID WASTE, *Hawaii, US*

SOLID WASTE

Types of waste:

Biodegradable waste: food and kitchen waste, green waste, paper (can be recycled);
Recyclable material: paper, glass bottles, cans, metals, certain plastics, etc.;
Inert waste: construction and demolition waste, dirt, rocks, debris;
Composite wastes: waste closing, Tetra Packs, waste plastics such as toys;

Domestic hazardous waste & toxic waste :

- medication or drugs,
- E-waste,
- paints,
- chemicals,
- light bulbs or fluorescent tubes,
- spray cans,
- fertilizers and pesticides and their containers,
- batteries,
- shoe polish materials.,
- *etc.*

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SOLID WASTE

Waste is solid substances generated as a result of human activities, and, being no longer of value for the respective economic, physiological or technological process, are removed from it.

Solid waste in a broader sense is understood as any household, industrial and agricultural materials that have been used up.

Since such waste accumulates in the territories managed by municipalities responsible for its removal and storage, it is termed ‘municipal solid waste’.

Municipal solid waste include also:

- **ash generated in thermal or electric power plants**
- **sludge from wastewater treatment plants**
- **animal farm waste**
- **gangue rocks from mineral extraction**

Sometimes these types of waste require separate sectors in landfills.

SOLID WASTE

BIODEGRADABLE WASTE

- Biodegradable waste is a type of waste, typically originating from plant or animal sources, which may be degraded by other living organisms.

Waste that cannot be broken down by other living organisms are called non-biodegradable.

- Biodegradable waste can be commonly found in municipal solid waste as green waste, food waste, paper waste, and biodegradable plastics.
- Other biodegradable wastes include human waste, manure, sewage, sloughterhouse waste.

In the absence of oxygen much of this waste will decay to methane by anaerobic digestion.

BIODEGRADABLE WASTE

- Biodegradable waste can often be used for composting or must be a resource for heat, electricity and fuel in future.
- This produces additional biogas and still delivers the compost for the soil.
- The oldest of the companies own lorries has achieved 1.000.000 kilometres driven with biogas from household waste in the last 15 years.

BIOGAS

Biogas typically refers to a gas produced by the biological breakdown of organic matter in the absence of oxygen. Organic waste such as dead plant and animal material, animal dung, and kitchen waste can be converted into a gaseous fuel called biogas. Biogas originates from biogenic material and is a type of biofuel.

Biogas comprises primarily methane (CH_4) and carbon dioxide (CO_2) and may have small amounts of hydrogen sulphide (H_2S) and moisture.

The gases methane, hydrogen, and carbon monoxide can be combusted or oxidized with oxygen. This energy release allows biogas to be used as a fuel.

Biogas can be used as a fuel in any country for any heating purpose, such as cooking. It can also be used in anaerobic digesters where it is typically used in a gas engine to convert the energy in the gas into electricity and heat.

Biogas can be compressed, much like natural gas, and used to power motor vehicles.

In the UK, for example, biogas is estimated to have the potential to replace around 17% of vehicle fuel.

Biogas is a renewable fuel, so it qualifies for renewable energy subsidies in some parts of the world.

Biogas can also be cleaned and upgraded to natural gas standards when it becomes biomethane.

Pipes carrying biogas, natural gas and condensate.

Biogas production in rural Germany.

GREEN WASTE

Green waste is biodegradable waste that can be composed of garden or park waste1, such as grass or flower cuttings and hedge (*dzīvžoga*) trimmings, as well as domestic and commercial food waste.

The differentiation *green* identifies it as high in nitrogen, as opposed to *brown* waste, which is primarily carbonaceous.

Green waste is often collected in municipal collection schemes or through private waste management contractor businesses.

FOOD WASTE

Food waste or food loss is food that is discarded or lost uneaten. As of 2011, 1.3 billion tons of food, about one third of the global food production, are lost or wasted annually. Loss and wastage occurs on all steps in the food supply chain. In low-income countries most loss occurs during production, while in developed countries much food – about 100 kilograms per person and year – is wasted at the consumption stage.

Limiting food wastage has seen the adoption of former WWI and II slogans.

LOVE FOOD hate waste

Apples (*Granny Smith variety*) are among the most wasted foods in the UK - 190,000 tonnes per year are thrown away.

FOOD LOSS AND WASTE

Food loss and waste per person and year	Total, *kg*	At the production and retail stages, *kg*	By consumers, *kg*
Europe	280	190	90
North America and Oceania	295	185	110
Industrialized Asia	240	160	80
Subsaharan Africa	160	155	5
North Africa, West and Central Asia	215	180	35
South and Southeast Asia	125	110	15
Latin America	225	200	25

Food loss measures the decrease in edible food mass (excluding inedible parts and seed), that is, loss at the production, post-harvest and processing stages. This definition of loss includes biomass originally meant for human consumption but eventually used for some other purpose, such as fuel or animal feed.

Food waste are food losses occurring during the retail and final consumption stage due to the behaviour of retailers and consumers – that is, the throwing away of food.

CONSTRUCTION WASTE

Construction waste consists of unwanted material produced directly or incidentally by the construction or industries.

This includes building materials such as insulation, nails, electrical wiring, as well as waste originating from site preparation such as dredging (*bagarētie*) materials, tree stumps, and rubble.

Construction waste may contain lead, asbestos, or other hazardous substances.

Much building waste is made up of materials such as bricks, concrete and wood damaged or unused for various reasons during construction.

Observational research has shown that this can be as high as 10 to 15 % of the materials that go into a building, a much higher percentage than the 2.5-5 % usually assumed by quantity surveyors and the construction industry.

Since considerable variability exists between construction sites, there is much opportunity for reducing this waste.

CONSTRUCTION WASTE

Certain components of construction waste such as plasterboards are hazardous once landfilled. Plasterboard is broken down in landfill conditions releasing hydrogen sulphide, a toxic gas.

There is the potential to recycle many elements of construction waste. Often roll-off containers are used to transport the waste. Rubble can be crushed and reused in construction projects. Waste wood can also be recovered and recycled.

Government or local authorities often make rules about how much waste should be sorted before it is hauled away to landfills or other waste treatment facilities.

Some hazardous materials may not be moved, before the authorities have ascertained that safety guidelines and restrictions have been followed.

Among their concerns would be the proper handling and disposal of such toxic elements as lead, asbestos or radioactive materials.

CONSTRUCTION WASTE

Polyurethane insulator material marked for removal of the construction site. This material is quite wasteful and alternatives as compressed straw could be better used instead.

THE FUNCTIONAL ELEMENTS OF SOLID WASTE

Waste generation - encompasses activities in which materials are identified as no longer being of value and are either thrown out or gathered together for disposal.

Collection - the functional element of collection includes not only the gathering of solid waste and recyclable materials, but also the transport of these materials, after collection, to the location where the collection vehicle is emptied. This location may be a materials processing facility, a transfer station or a landfill disposal site.

Waste handling and separation, storage and processing at the source - involves activities associated with waste management until the waste is placed in storage containers for collection. Handling also encompasses the movement of loaded containers to the point of collection. Separating different types of waste components is an important step in the handling and storage of solid waste at the source.

Separation and processing and transformation of solid wastes - the types of means and facilities that are now used for the recovery of waste materials that have been separated at the source include curbside collection, drop off and buy back centers. The separation and processing of wastes that have been separated at the source and the separation of commingled wastes usually occur at a materials recovery facility, transfer stations, combustion facilities and disposal sites.

THE FUNCTIONAL ELEMENTS OF SOLID WASTE

Transfer and transport - this element involves two main steps. First, the waste is transferred from a smaller collection vehicle to larger transport equipment. The waste is then transported, usually over long distances, to a processing or disposal site.

Disposal - today, the disposal of wastes by land filling or land spreading is the ultimate fate of all solid wastes, whether they are residential wastes collected and transported directly to a landfill site, residual materials from material recovery facilities, residue from the combustion of solid waste, compost, or other substances from various solid waste processing facilities.

A modern sanitary landfill is not a dump; it is an engineered facility used for disposing of solid wastes on land without creating nuisances or hazards to public health or safety, such as the breeding of insects and the contamination of ground water.

Energy generation - municipal solid waste can be used to generate energy. Several technologies have been developed that make the processing for energy generation cleaner and more economical than ever before, including landfill gas capture, combustion, pyrolysis, gasification.

WASTE MANAGEMENT

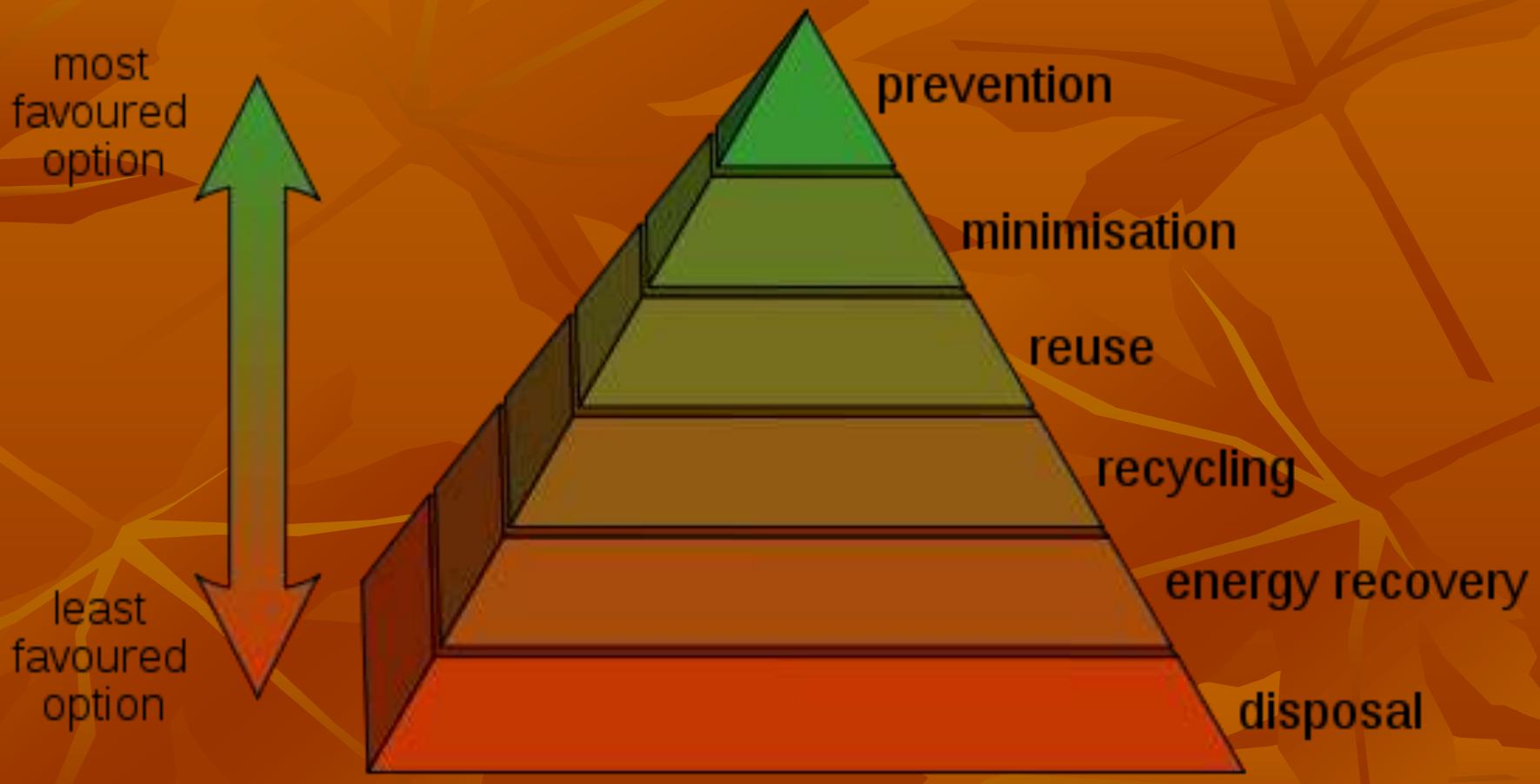
The aim of sustainable waste management is to reduce waste formation and to use resources more efficiently and rationally, ensuring that the waste of one sector is used as a raw material in another sector.

It is estimated that the amount of solid waste per capita is around 500 kilograms per year. However, this figure may vary greatly in different cities and seasons.

Disposal of solid waste or waste incineration ash in sanitary polygons can endanger groundwater or surface water sources.

Therefore, the construction of sanitary polygons has to be planned very carefully, and their operation has to be strictly monitored in order to prevent groundwater pollution.

WASTE MANAGEMENT HIERARHY



WASTE MANAGEMENT 3R CONCEPT

- The **waste hierarchy** refers to the 3 (or 4) R's of **reduce, reuse, recycle, (recovery)** which classify waste management strategies according to their desirability.
- The R's are meant to be a hierarchy, in order of importance. However in Europe the waste hierarchy has 5 steps: reduce, reuse, recycle, recovery, and disposal.
- **The aim of the waste hierarchy is to extract the maximum practical benefits from products and to generate the minimum amount of waste.**

Some waste management experts have recently incorporated a additional R: "Re-think", that effective system of waste management may need an entirely new way of looking at waste.

- *Source reduction* involves efforts to reduce hazardous waste and other materials by modifying industrial production.
- Source reduction methods involve changes in manufacturing technology, raw material inputs, and product formulation.
- At times, the term "pollution prevention" may refer to source reduction.

REDUCE

Waste minimisation is the process and the policy of reducing the amount of waste produced by a person or a society.

Waste minimisation involves efforts to minimise resource and energy use during manufacture. For the same commercial output, usually the fewer materials are used, the less waste is produced.

Waste minimisation usually requires knowledge of the production process, cradle-to-grave (now *cradle-to-cradle*) analysis - the tracking of materials from their extraction to their return to earth (start a new cycle) and detailed knowledge of the composition of the waste.

The main sources of waste vary from country to country. In the UK, most waste comes from the construction and demolition of buildings, followed by mining, industry and commerce. Household waste constitutes a relatively small proportion of all waste.

In the waste hierarchy, the most effective approaches to managing waste are at the top. In contrast to waste minimisation, waste management focuses on processing waste after it is created, concentrating on re-use, recycling, and waste-to-energy conversion.

REDUCE

In industries, using more efficient manufacturing processes and better materials will generally reduce the production of waste. The application of waste minimisation techniques has led to the development of innovative and commercially successful replacement products. Waste minimisation has proven benefits to industry and the wider environment.

Waste minimisation often requires investment, which is usually compensated by the savings. However, waste reduction in one part of the production process may create waste production in another part.

There are government incentives for waste minimisation, which focus on the environmental benefits of adopting waste minimisation strategies.

REDUCE

RESOURCE OPTIMISATION - Minimising the amount of waste produced by organisations or individuals goes hand-in-hand with optimising their use of raw materials. For example, a dressmaker may arrange pattern pieces on a length of fabric in a particular way to enable the garment to be cut out from the smallest area of fabric.

REUSE OF SCRAPS MATERIAL - Scraps can be immediately re-incorporated at the beginning of the manufacturing line so that they do not become a waste product. Many industries routinely do this; for example, paper mills return any damaged rolls to the beginning of the production line, and in the manufacture of plastic items, off-cuts and scrap are re-incorporated into new products.

IMPROVED QUALITY CONTROL AND PROCESS MONITORING - Steps can be taken to ensure that the number of reject batches is kept to a minimum. This is achieved by increasing the frequency of inspection and the number of points of inspection. For example, installing automated continuous monitoring equipment can help to identify production problems at an early stage.

WASTE EXCHANGES - This is where the waste product of one process becomes the raw material for a second process. Waste exchanges represent another way of reducing waste disposal volumes for waste that cannot be eliminated.

SHIP TO POINT OF USE - This involves making deliveries of incoming raw materials or components direct to the point where they are assembled or used in the manufacturing process to minimise handling and the use of protective wrappings or enclosures.

REUSE

To reuse is to use an item more than once. This includes conventional reuse where the item is used again for the same function, and new-life reuse where it is used for a different function. In contrast, recycling is the breaking down of the used item into raw materials which are used to make new items.

By taking useful products and exchanging them, without reprocessing, reuse help save time, money, energy, and resources. In broader economic terms, reuse offers quality products to people and organizations with limited means, while generating jobs and business activity that contribute to the economy.

Historically, financial motivation was one of the main drivers of reuse. In the developing world this driver can lead to very high levels of reuse,

However rising wages and consequent consumer demand for the convenience of disposable products has made the reuse of low value items such as packaging uneconomic in richer countries, leading to the demise of many reuse programs.

Current environmental awareness is gradually changing attitudes and regulations, such as the new packaging regulations, are gradually beginning to reverse the situation.

One example of conventional reuse is the doorstep delivery of milk in refillable bottles; other examples include the retreading of tires and the use of returnable/reusable plastic boxes, shipping containers, instead of single-use corrugated (*rievots*) fiberboard boxes.

REUSE

Tires, bottles and cans as building materials

An electric wire reel reused as a center table in a Rio de Janeiro fair

Reusable glass bottles collected in Bishkek Kyrgyzstan. Deposit values (0.5-2 Kyrgyz som) are posted next to the sample bottles on the rack

RECYCLING

Recycling of materials and substances contained in solid waste is very simple in theory but extremely hard in practice. People have always collected utilisable and valuable materials (e.g. metals) from waste and used them in industry because it is cheaper than extracting them from raw materials.

It is also useful to separate cheap materials from waste because they still have some value (old newspapers to produce pulp and new paper) or it is inconvenient to throw them away (bottles).

Economic reasons are decisive for the reuse of materials. For the time being, to produce glass from natural raw materials is cheaper than from discarded, used glass, and using glass chippings to replace stones in the road or street construction consumes much more energy.

In many countries regulations require sorting waste at the source. Residents need to sort waste into such types as food scraps, paper, ash and glass.

There are some ISO standards relating to recycling such as ISO 15270:2008 for plastics waste and ISO 14001: 2004 for environmental management control of recycling practice as well as EU directives.

RECYCLING

Publicity photo for US aluminium salvage campaign in 1942

Recycling and rubbish bin in a railway station, Germany

Early sorting of recyclable materials: glass and plastic bottles in Poland

Sign at Tamil Nandi, India

ENVIRONMENTAL EFFECTS OF RECYCLING

Material	Energy savings	Air pollution savings
Aluminium	95 %	95 %
Cardboard	24 %	—
Glass	5 - 30 %	20 %
Paper	40 %	73 %
Plastics	70 %	—
Steel	60 %	—

WASTE COLLECTION

Solid waste collection and transporting

A front-loading garbage truck in North America.

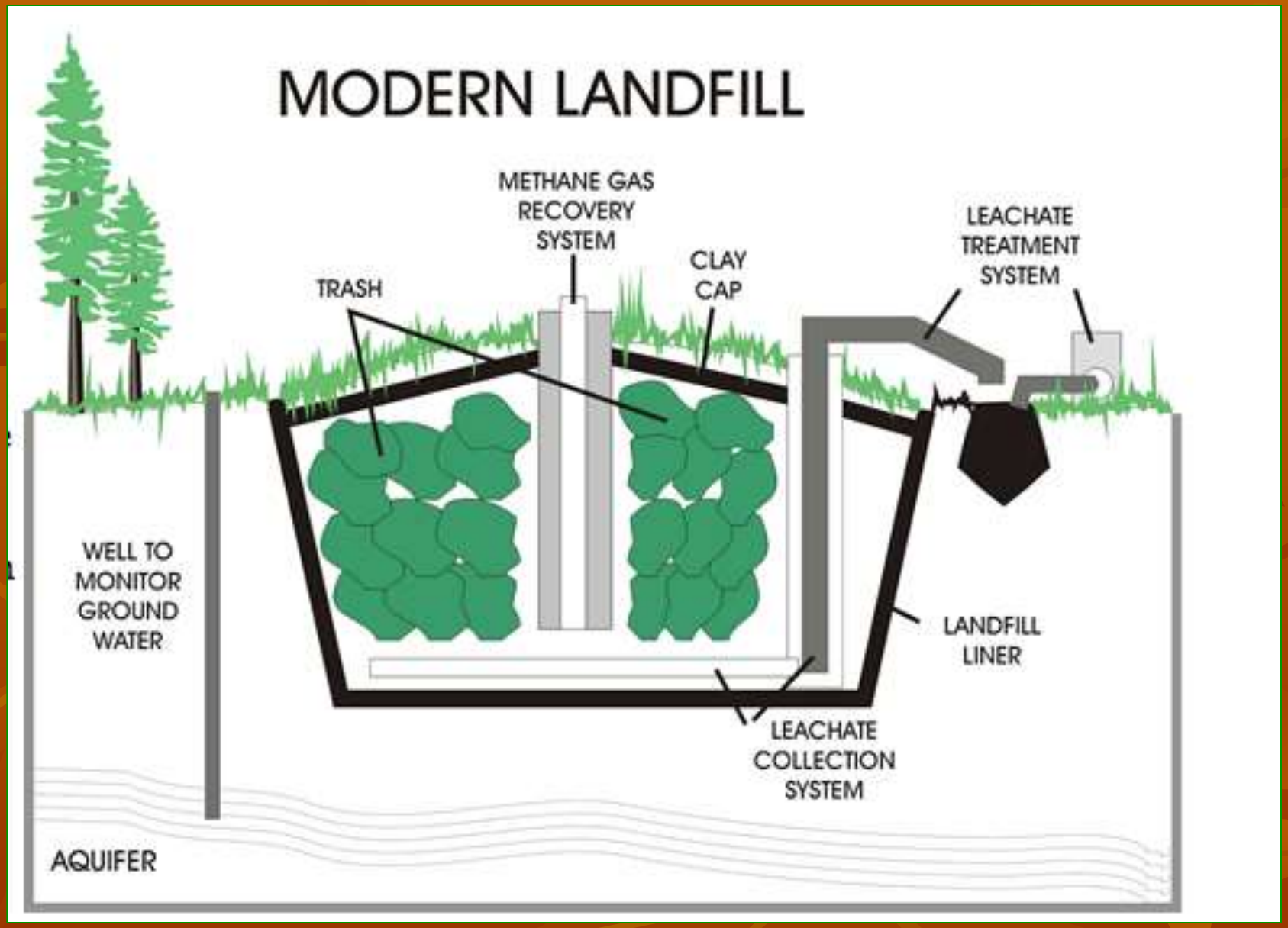
Solid waste collection and transporting, Nepal

The weigh bridge is the two part platform over which trucks are driven. The upper works is auxiliary equipment for leveling the load in the truck and is not part of the scale. This scale uses electronic measuring equipment.

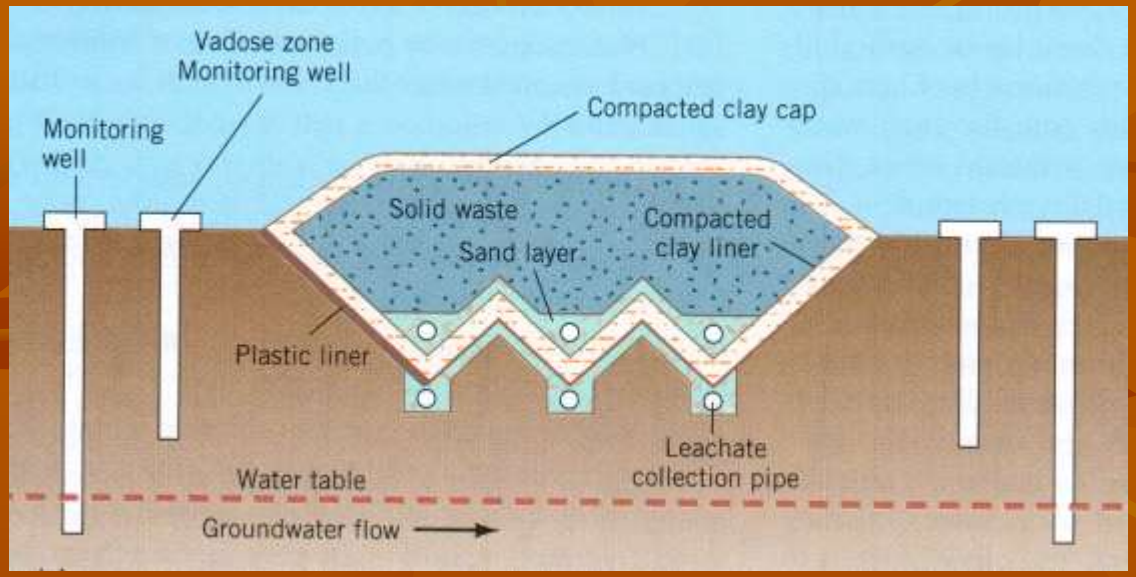
LANDFILLING

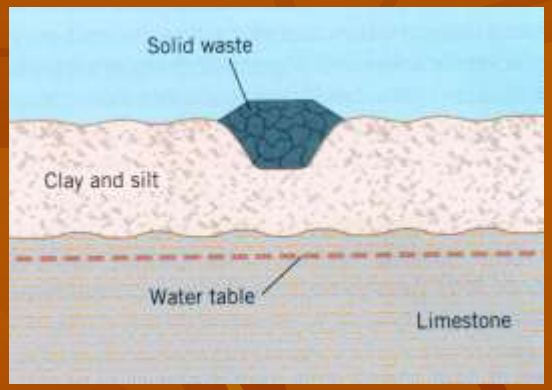
LANDFILLING

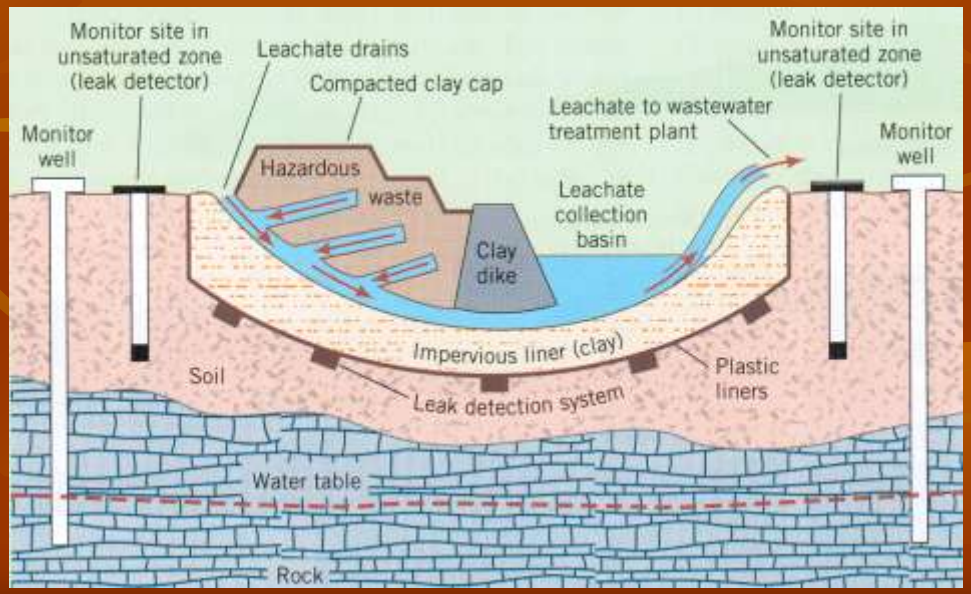
Landfill operation. The area being filled is a single, well-defined "cell" and a rubberized landfill liner is in place to prevent contamination by leachates migrating downward through the underlying geological formation.


MODERN LANDFILL
METHANE GAS RECOVERY SYSTEM
TRASH
CLAY CAP
LEACHATE TREATMENT SYSTEM
WELL TO MONITOR GROUND WATER
LANDFILL LINER
LEACHATE COLLECTION SYSTEM
AQUIFER

Construction of sanitary landfills







LANDFILLING

South East New Territories Landfill, Hong Kong

SANITARY LANDFILL

USA, New York, Staten Island,
Fresh Kills

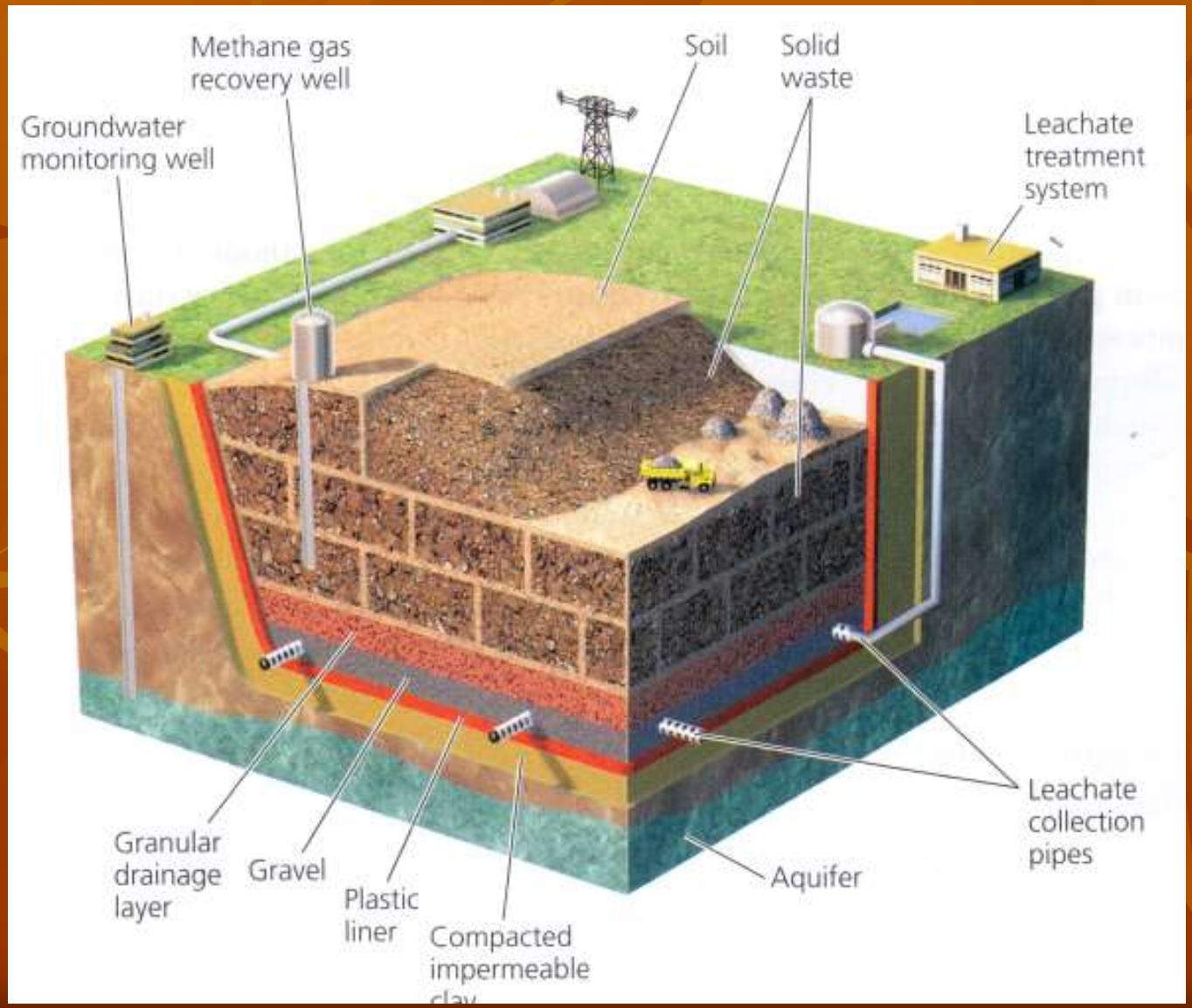
Landfill compacting

Landfill compactors

Rammax remote controlled compactor.

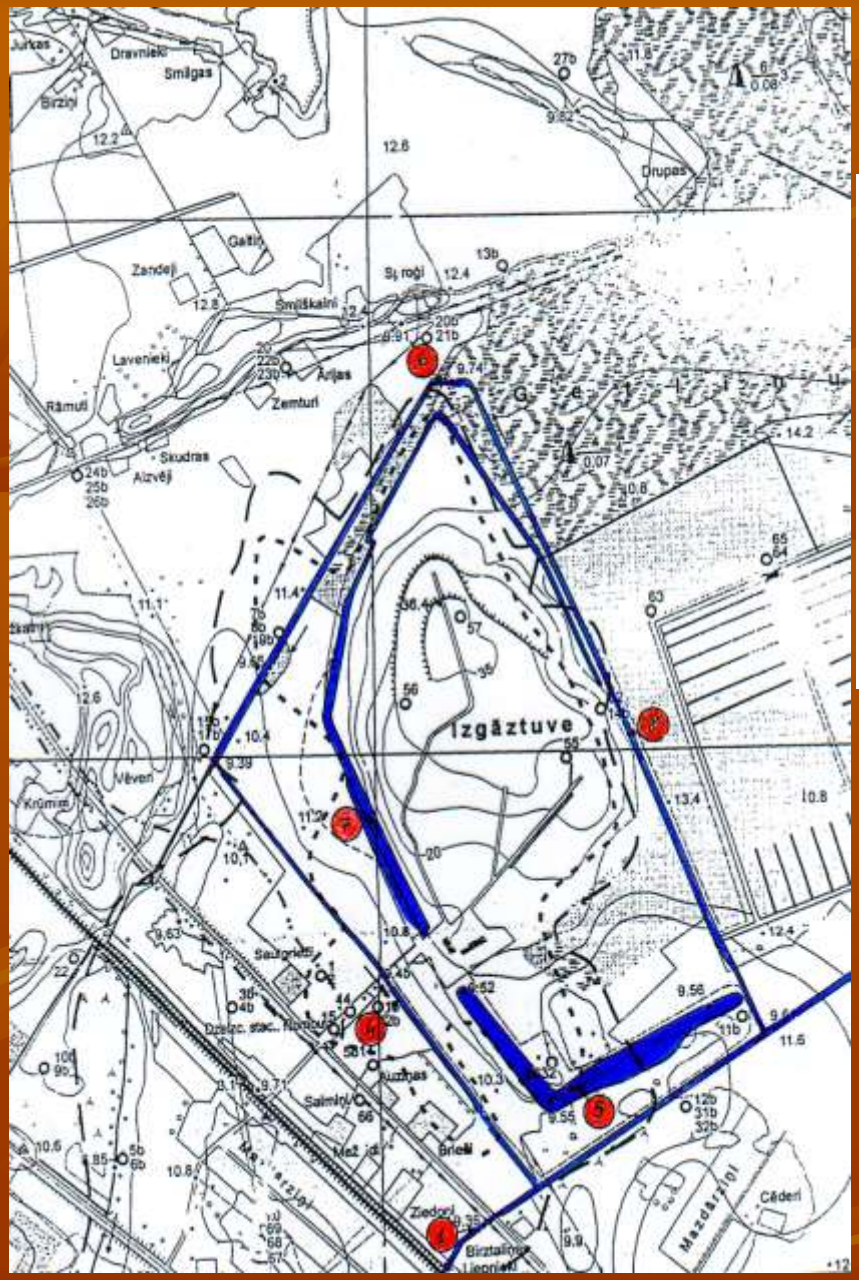
A sheepsfoot compactor/roller operated by U.S. Navy Seabees

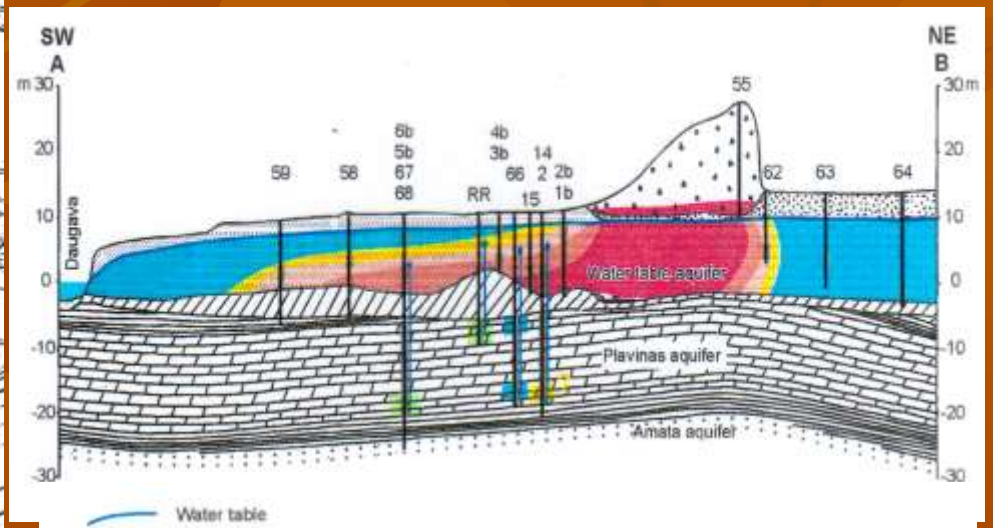
MODERN SANITARY LANDFILL



MODERN SANITARY LANDFILL IN GETLINI FOR RIGA CITY


N
Jurmala
JŪRMALA
RIGA
Getlini
SALASPILS
Marupe
Jaunmārupe
Olaine
OLAINE
KALNCIEMS
BALOŽI
Ķekava
BALDONE





Water table

Groundwater level in (Plavinas confined aquifer)

Monitoring well and filter interval

Lithological composition

Waste | Sand | Clay and marl | Sandstone

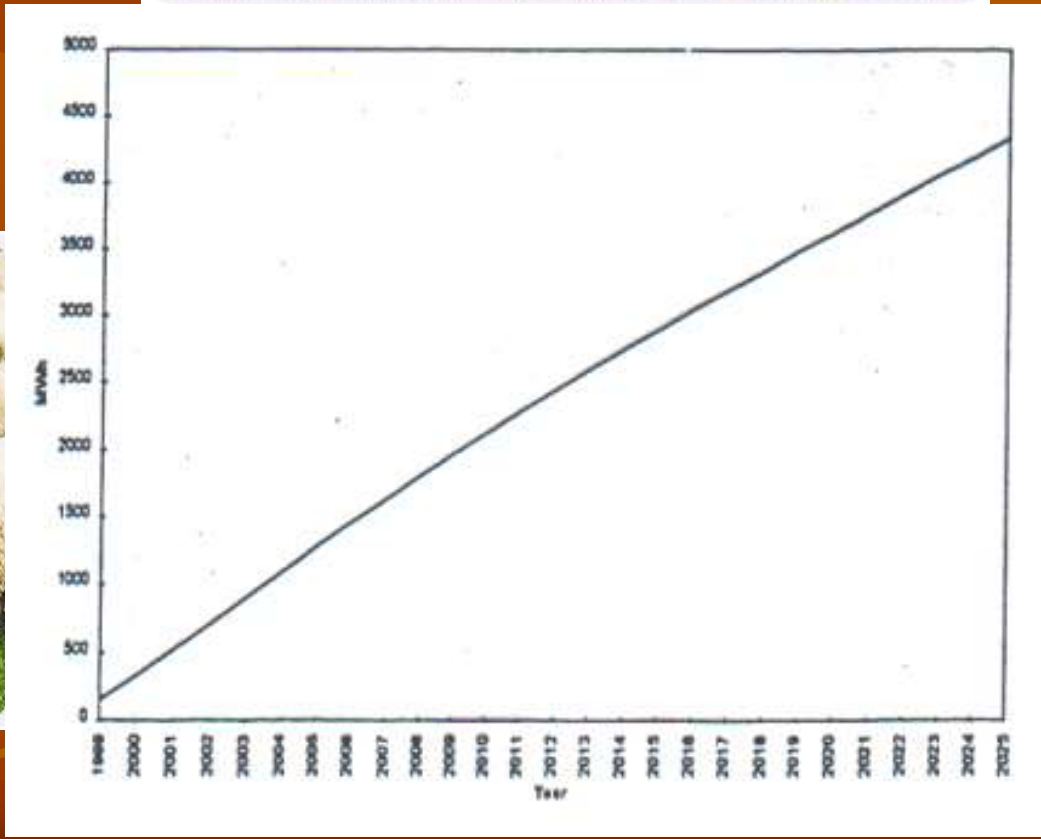
Peat | Silt and till | Dolomite

Groundwater quality

Color	Type of water	Cl⁻, mg/l	COD-Cr, mgO₂/l
	Clean	<40	Does not exceed background value
	Slightly contaminated	100-300	<100
	Contaminated	300-1000	100-300
	Strongly contaminated	1000-3000	300-1000
	Very strongly contaminated (leachate)	3000-10 000	1000-6000
	Unknown	40-100	Does not exceed background value

ENERGY FROM BIOGAS IN GETLINI

Gads	Saražotā elektroenerģija, MWh	Sadedzinātais metāna daudzums, m^3	Sadedzinātais metāna daudzums, t	CO_2 ekv. tonnas
2002	5 098	1 283 676	911	19 131
2003	17 887	4 503 946	3 197	67 137
2004	25 748	6 483 346	4 603	96 663
2005	25 425	6 402 015	4 545	95 445
2006	26 331	6 635 412	4 755	99 855
2007	27 361	6 894 972	4 936	103 656
2008	28 742	7 242 984	5 184	108 864
2009	31 130	7 844 760	5 569	116 949
2010	31 099	7 836 984	5 564	116 844
2011	31 295	7 889 928	5 601	117 621


5000
4500
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MWh
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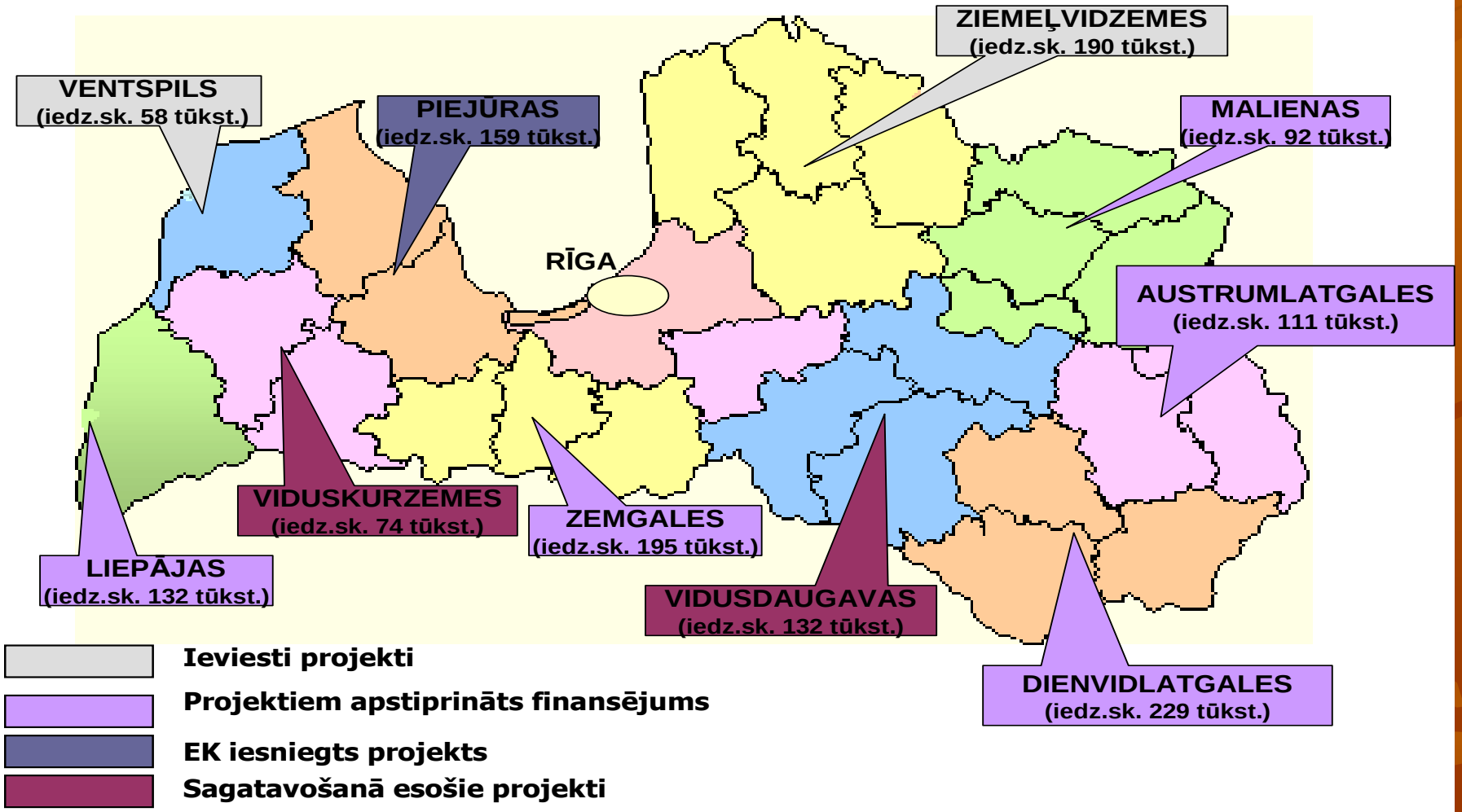
2025
Year

Sadzīves atkritumu apsaimniekošanas reģionālie projekti un to statuss (2005.gads)



REKULTIVATION OF LANDFILLS

Incineration plant

The Spittelau incineration plant in Vienna, designed by Friedensreich Hundertwasser

Incineration is a waste treatment process that involves the combustion of organic substances contained in waste materials.

Incineration and other high temperature waste treatment systems are described as “thermal treatment” .

Incineration of waste materials converts the waste into ash, flue gas, and heat.

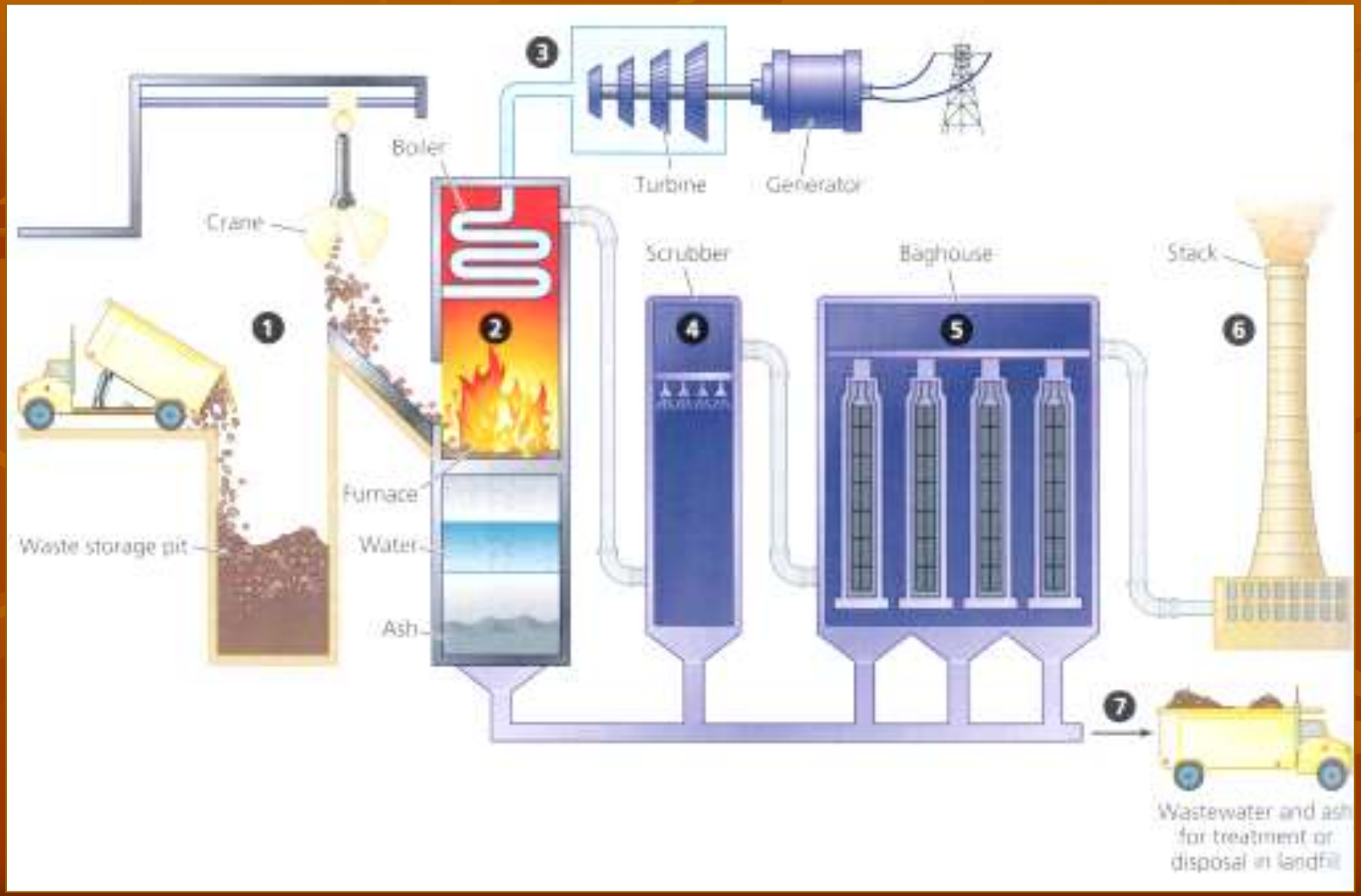
The ash is mostly formed by the inorganic constituents of the waste, and may take the form of solid lumps or particulates carried by the flue gas.

The flue gases must be cleaned of gaseous and particulate pollutants before they are dispersed into the atmosphere.

In some cases, the heat generated by incineration can be used to generate generate electric power.

SYSAV incineration plant in Malmo, Sweden capable of handling 25 metric tons per hour household waste.
To the left of the main stack, a new identical oven line is under construction.

Incineration plant



Composting

A large compost pile that is steaming with the heat generated by thermophilic microorganisms.

Composting organisms require four equally important things to work effectively:

Carbon — for energy; the microbial oxidation of carbon produces the heat, if included at suggested levels.

High carbon materials tend to be brown and dry.

Nitrogen — to grow and reproduce more organisms to oxidize the carbon.

High nitrogen materials tend to be green (or colorful, such as fruits and vegetables) and wet.[7]

Oxygen — for oxidizing the carbon, the decomposition process.

Water — in the right amounts to maintain activity without causing anaerobic conditions.

Compost

Compost is organic matter that has been decomposed and recycled as a fertilizer and soil amendment. Compost is a key ingredient in organic farming. At its most essential, the process of composting requires simply piling up waste outdoors and waiting for the materials to break down from anywhere between 5-6 weeks or even more.

Modern, methodical composting is a multi-step, closely monitored process with measured inputs of water, air and carbon- and nitrogen-rich materials. The decomposition process is aided by shredding the plant matter, adding water and ensuring proper aeration by regularly turning the mixture. Worms and fungi further break up the material.

Aerobic bacteria manage the chemical process by converting the inputs into heat, carbon dioxide and ammonium. The ammonium is further converted by bacteria into plant-nourishing nitrites and nitrates through the process of nitrification.

Compost can be rich in nutrients. It is used in gardens, landscaping, and agriculture. The compost itself is beneficial for the land in many ways, including as a soil conditioner, a fertilizer, addition of vital humus or humic acids, and as a natural pesticide for soil.

In ecosystems, compost is useful for erosion control, land and stream reclamation, wetland construction, and as landfill cover. Organic ingredients intended for composting can alternatively be used to generate biogas through anaerobic digestion.

Anaerobic digestion is fast overtaking composting in some parts of the world including central Europe as a primary means of downcycling waste organic matter.

A modern compost bin constructed from plastics

Composting plant

Composting plant, Edmonton, Canada

Thank You for attention !