unitar
United Nations Institute for Training and Research

# GUIDELINES ON TECHNIQUES AND PRACTICES

## To Reduce / Eliminate

## Open Burning of Waste in the SADC Region (BAT/BEP)

Photo Credit : Linda Godfrey

CHEMICALS & WASTE MANAGEMENT- cwm@unitar.org

Massimo Gobbi, Jakob Maag & Nelson Manda

# Burning Processes in the SADC Region

## Open burning in:

Backyards
*(home burning)*

*1Photo: U.S.EPA*

Informal dumps

*1Photo Massimo Gobbi*

Accidents

*Photo Source: https://www.von.gov.ng/lagos-begins-capping-of-controversial-dumpsite/*

# Causes of Open Burning

## Open burning of waste is caused by:

*3Photo Massimo Gobbi*

*4Photo Massimo Gobbi*

Photo Massimo Gobbi

No waste collection (structural problems or because people cannot pay waste fees)

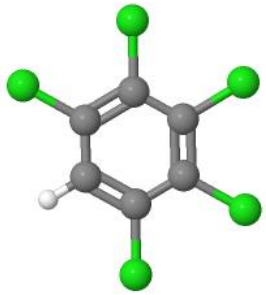
Waste pickers (at dumpsite)

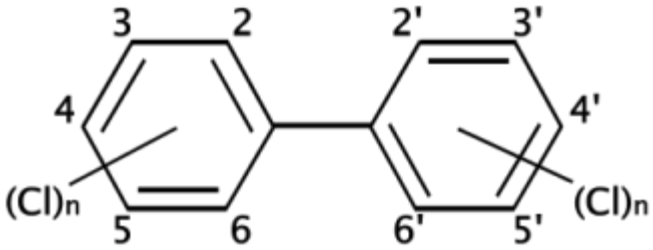
Spontaneous ignition (at dumpsite)

Unauthorized burning (at dumpsite)

## Generation of Unintentionally Generated Persistent Organic Pollutants (uPOPs)

Dioxins, Furans and other unintentional POPs can be formed in combustion processes when their component elements – carbon, oxygen, hydrogen, and chloride – are present and combustion temperatures range between 200°C and 900°C



# Which wastes are worst to burn?

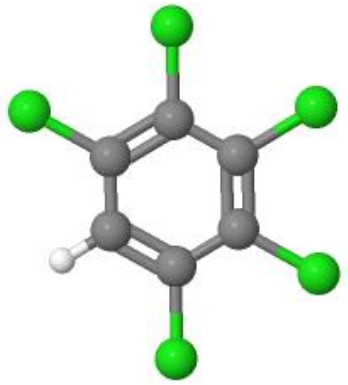
## How the emissions causing health risks are measured

### The Emission Factor

Dioxins, Furans and other unintentional POPs have been assigned a toxicity equivalency factor (TEF) and are reported as a single number called toxic equivalent (TEQ).

Due to the very high toxicity, values are expressed in emissions of micrograms per ton of burned material: this unit of measure is named

**the Emission Factor (EF)**




**EF unit: µg TEQ**

# Which wastes are worst to burn?

- Emissions of dioxins/furans from burning of electric cables:

  **12,000 microgramsTEQ/ton cables**

- Emissions of dioxins/furans from burning of waste at dumpsites:

  **300 microgramsTEQ/ton waste**

- Emissions of dioxins and furans from coal power plants:

  **0.00025 microgramsTEQ/ton coal**

## Emissions From Open Burning of Waste

- **Dioxins and furans (most dangerous)**
- Volatile Organic Compounds (VOC)
- Polycyclic Aromatic Hydrocarbons (PAH)
- Mercury
- $CO_2$, CO, SOx, NOx;

## Health Risks From Handling Of Waste

- Sharp objects, toxic compounds, pathogens

# Effects of Exposure to Dioxins / Furans

*3 Photo Wordpress.com*

*2Photo News.com.au*

*2 Photo US Fish and Wildlife North East region-Wordpress.com*

**<u>Short-term</u> exposure to high levels:**

*4 Photo Nature education*

**<u>Chronic</u> exposure:**

Skin lesions such as chloracne and patchy darkening

Impairment of the immnune system, endocrine system and reproductive functions

## Main sources of health and safety problems

- **Backyards/homes**: emissions, use of ash for vegetable gardens
- **Illegal dumping sites**: emissions, leachate, risks from handling
- **Municipal dumpsites**: emissions, leachate, risks from handling
- **Landfills** (**when mismanaged**): emissions from spontaneous ignition

# How to reduce open burning of municipal solid waste

Credit : Linda Godfrey

# How to reduce open burning?

**Change peoples thinking!**
about waste

# Measures to Reduce Open Burning of Waste – informal burning

| Increase coverage of waste collection to avoid informal dumping and burning |
| --- |
| Use income from separated recyclables to pay for more collection |
| Improve collection of payments:<br>- Pay via electricity bill<br>- Increase awareness |
| Increase acceptance of higher collection fees through awareness rasing |

| Increase effectiveness of waste collection to avoid informal dumping and burning |
| --- |
| Improve contracts with service providers |
| Increase control and enforcement of services |

# Measures to Reduce Open Burning of Waste – at dumpsites

| Reduction of volume of waste to dumpsites by: | Improved management at municipal dumpsites: |
| --- | --- |
| Segregation at source of recyclables (plastics, paper, metals, glass) | Organization of waste pickers' activities (registration, PPEs, prohibition to burn) |
| Segregation of organic materials (for composting) | Improvement of dumpsite procedures (organization of cells, limited dumping area, spontaneous ignition control) |

## WACS - a mean for sound management of MSW

WACS at source and at dumpsite can provide useful information on waste composition for improved management of waste.

- Recycling activities
- Waste collection improvement

High content of recyclables at source (households) means potential for recycling activities. Door-to-door segregation of recyclables can be implemented as will take off materials from the stream to dumpsite;

Organic material from restaurants and vegetable markets is eligible for composting activities and production of high quality fertilizers;

Strategies for minimization of waste stream to dumpsite shall be preferred to activities at municipal dumpsites (sorting, dumpsite improvement);

# Composition of Mixed Consumer Waste (MSW)

Waste composition can differ in the SADC region and
can affect waste management policies

**MSW composition in the SADC region :**

- **Organic material**: Kitchen waste and garden trimmings can range from 0% to 70% at dumpsite
- **Recyclables**: Paper, plastics, glass, metals, etc.
  can range 30% to 90%
- **Non-recyclable material**: What is left from the two above categories

# Reduction of volume of waste to dumpsites by segregation and recycling

Credit : Linda Godfrey

# Low-tech sorting

# Manned belt sorting

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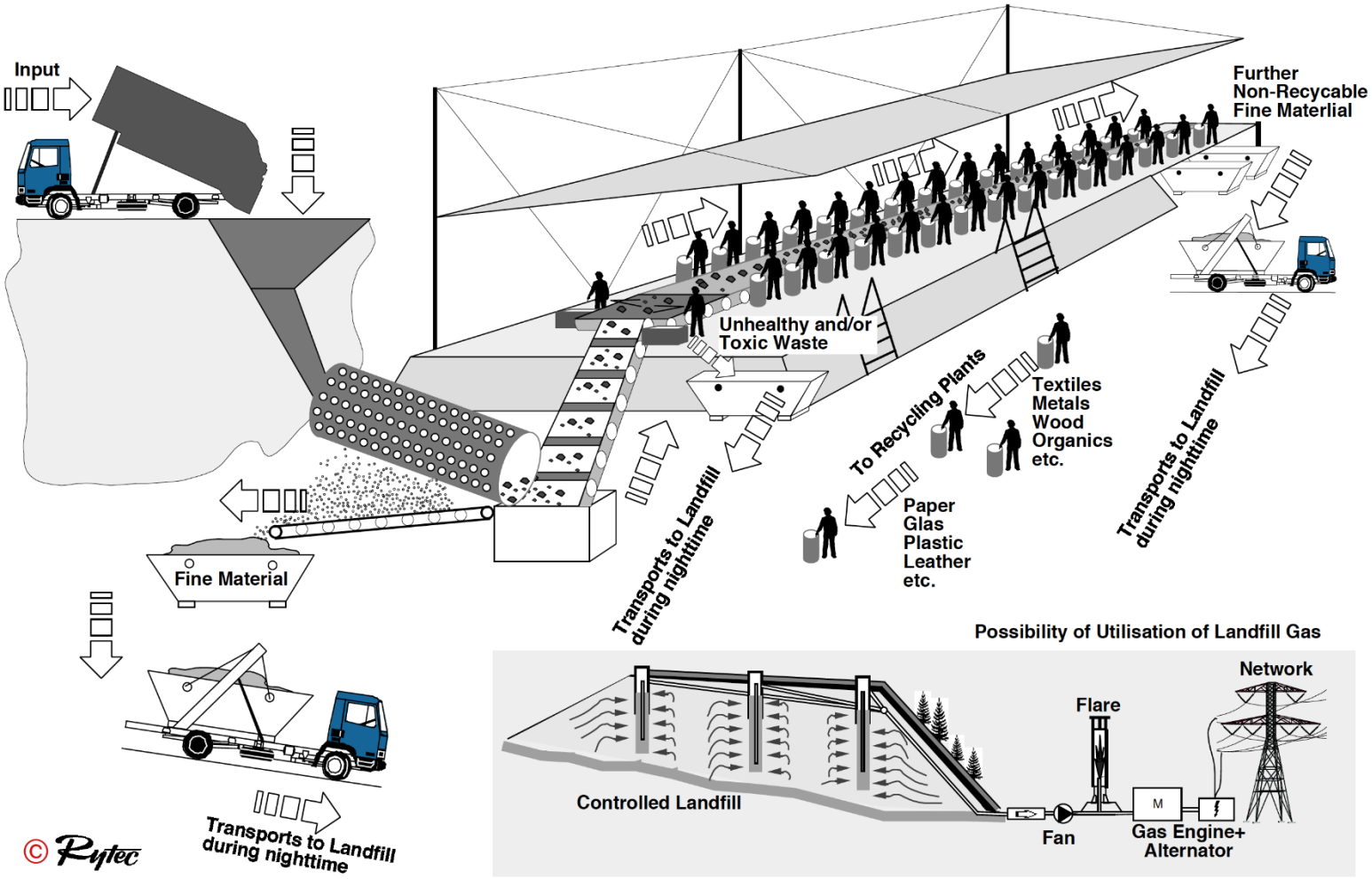
**Figure 7: Proposal for Sorting Devices at Various Places in a Township**



# Opportunities for Recycling in the SADC Region

## Segregation of plastics, paper, glass, metals:

*1Photo Massimo Gobbi*

*2 Photo Massimo Gobbi*

*2 Photo Massimo Gobbi*

Plastics, paper, glass and metals go to dumpsites or are collected as raw materials and transported to South Africa

Recycling can be improved by segregation at source

# Business Opportunities from Recyclables

*Granules - Photo Massimo Gobbi*

Production of ground and granulated materials

*Textiles -Photo Massimo Gobbi*

*Granules - Photo Massimo Gobbi*

Production of goods

*String, cord -Photo Massimo Gobbi*

*Profiles - Photo Massimo Gobbi*

*Tubes - Photo Massimo Gobbi*

# Plastics - Production of granules

*2 Photo Quingdao-China*

# Plastics - Production of pipes

*2Photo Quingdao - China*

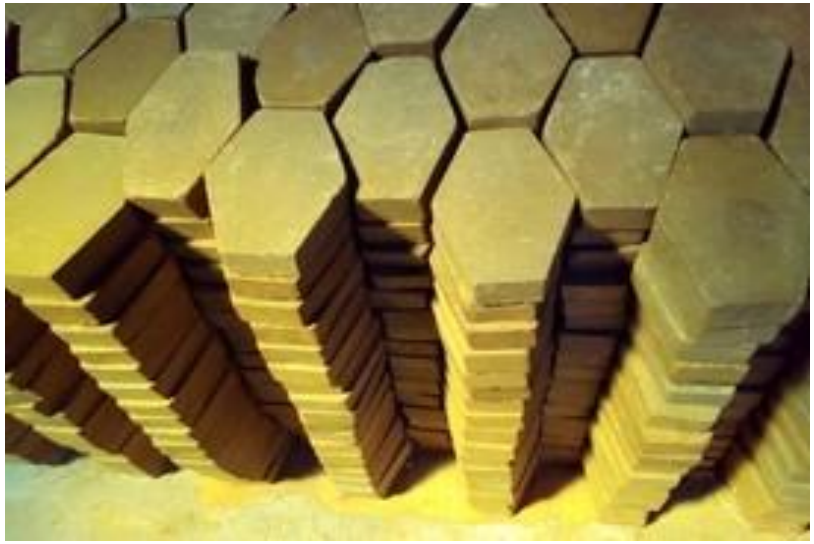
# Business Opportunities from Recyclables

**Plastics**

Production of bricks

Plastic discards are mixed with clay to produce bricks

*1Photo Massimo Gobbi*



*4 Photo Massimo Gobbi*

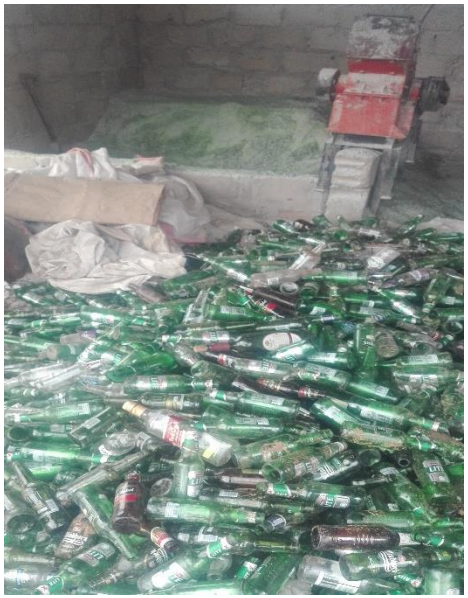
# Business Opportunities from Recyclables

**Glass**

Production of construction blocks

Or re-melt as bottles

Crushed glass is mixed with cement to produce construction blocks



*1 Photo Massimo Gobbi*

*1 Photo Massimo Gobbi*

# Business Opportunities from Recyclables

**Metals** → Production of goods

- Secondary aluminium

*1Photo Massimo Gobbi*

*1 Photo Massimo Gobbi*

Photo Massimo Gobbi

# Business Opportunities from Recyclables

**Textile discards** → Production of goods

For automotive, furniture and building construction

Photo Massimo Gobbi

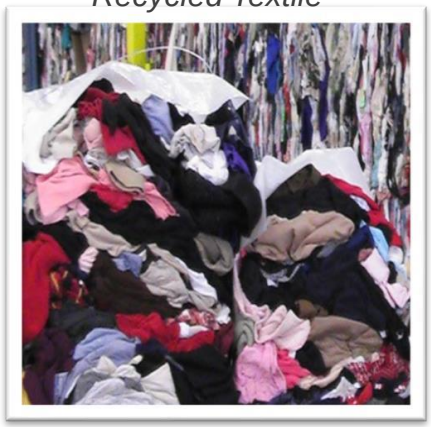
*1Photo Massimo Gobbi*

Photo Massimo Gobbi

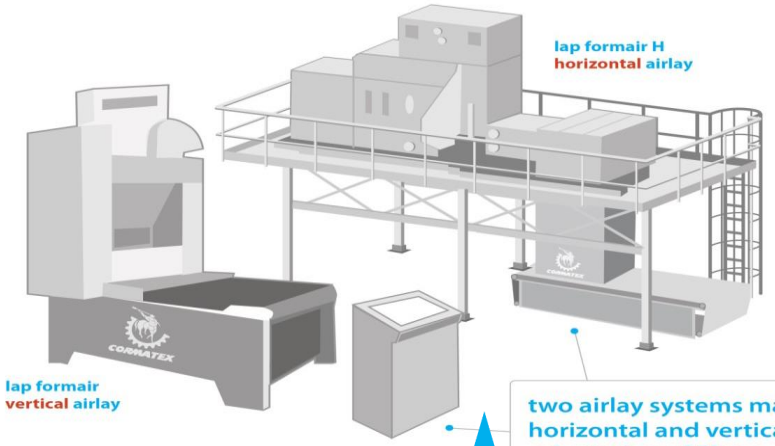
# Business Opportunities from Recyclables

**Textile discards**

*Recycled Textile*



*horizontal* **Lapp formair H**




**Lap formair V**

*vertical airlay*

*1Photo Cormatex-Italy*

*Building, automotive, furniture, insulation.*

# Best Available Techniques for Recycling Composting Plant

Organic material → Windrows turning → Screening → Bagging

*2Photo Globai Repair-Canada*

*2Photo Global Repair-Canada*

*2 Photo Global Repair -Canada*

# Improved management at municipal dumpsites

# Measures to Reduce Health and Safety Problems


- Stop open burning by waste pickers
- Restrict dumping area to facilitate sorting from pickers
- Organize dumpsite in cells
- Control leachate
- Extinguish fires as soon as detected

# Measures to Reduce Health and Safety Problems


- Organize and educate waste pickers to reduce risks
- Restrict access to the dumpsite/landfill (fences, guards)
- Limit dumping area to facilitate sorting for waste pickers
- Give organized waste pickers access to personal protection equipment

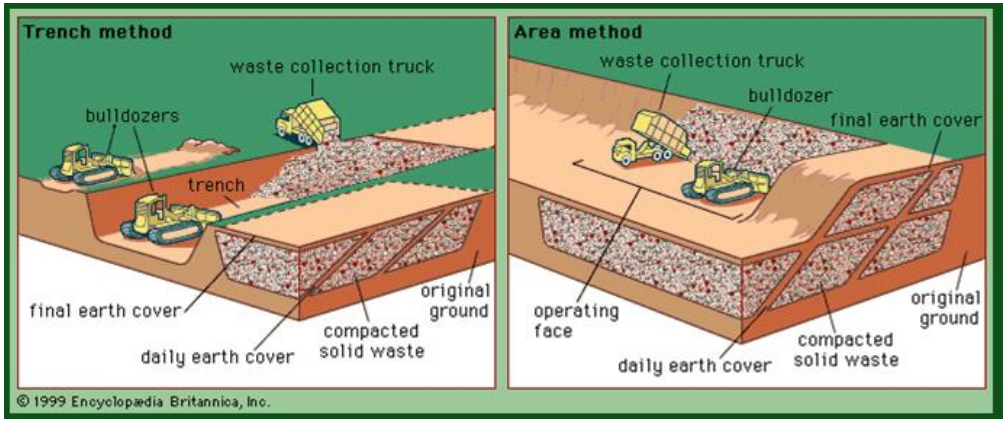
# Best Environmental Practices for Disposal of Waste

Rehabilitation of dumpsites
**<u>Divide</u> the dumpsite into cells**

Extends dumpsite's lifetime

+

Eliminates open burning



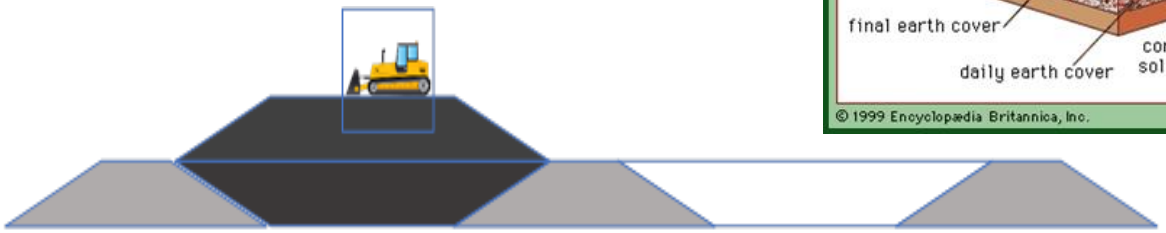



Figure 1 schematic of cell system

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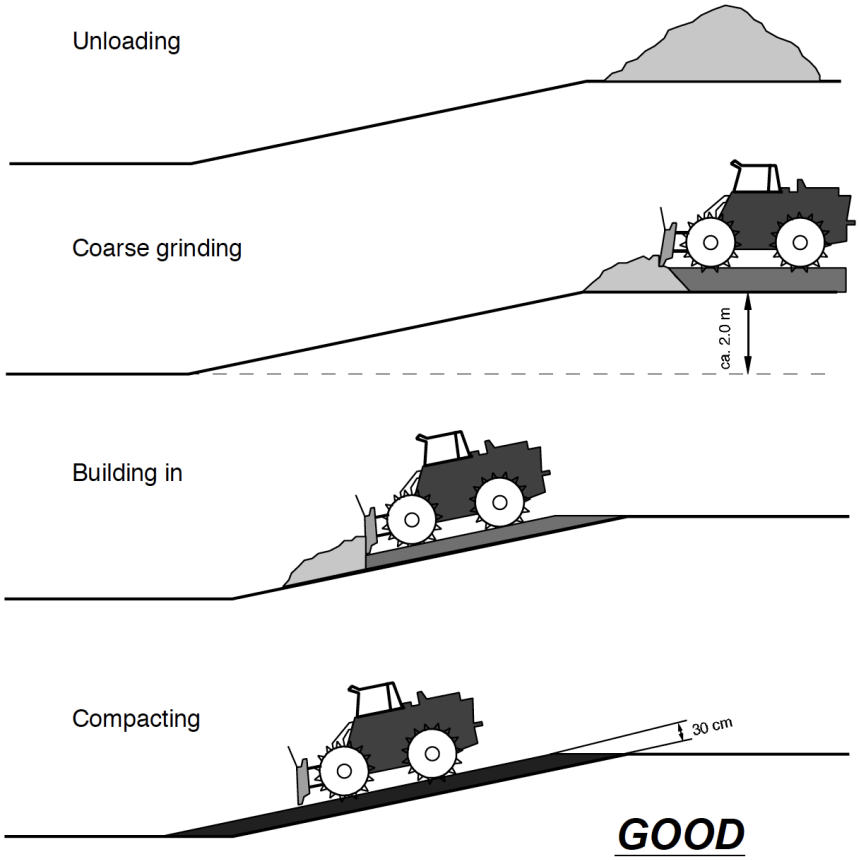
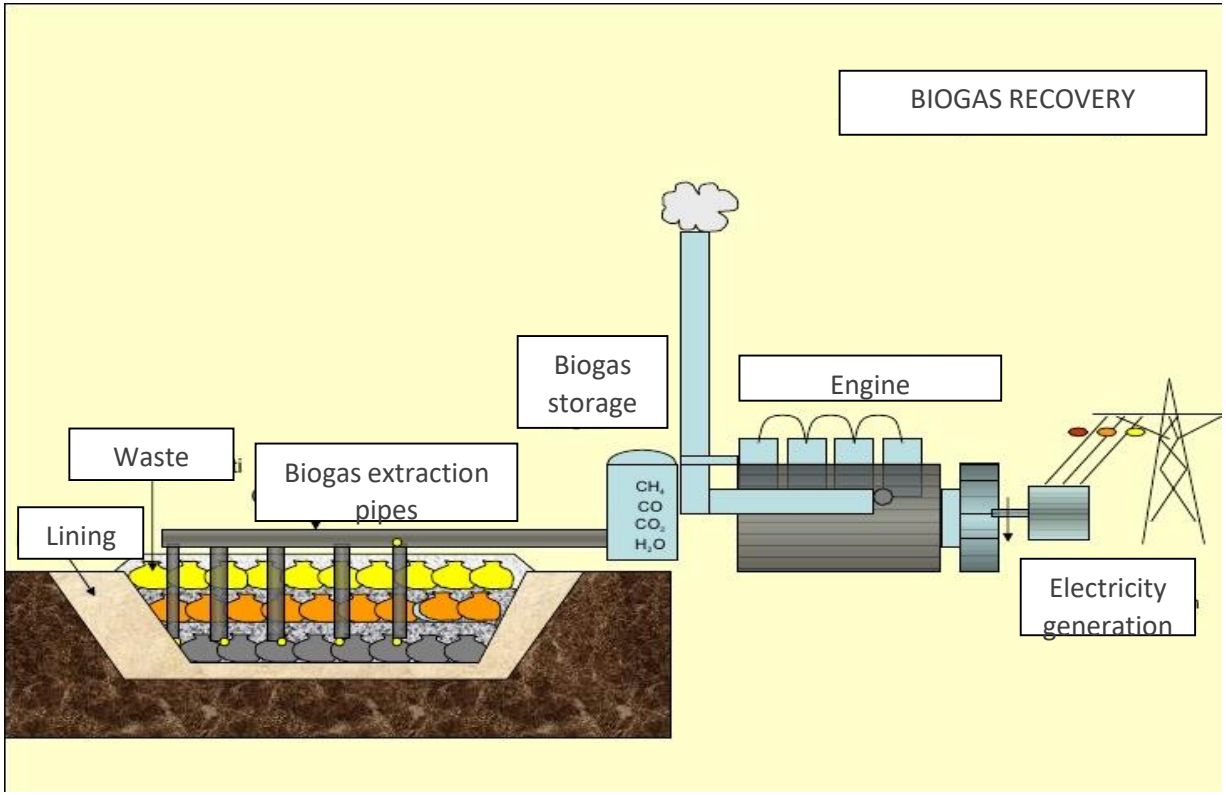
**Figure 61: Schematic representation of downward levelling (fronmatal emplacement)**

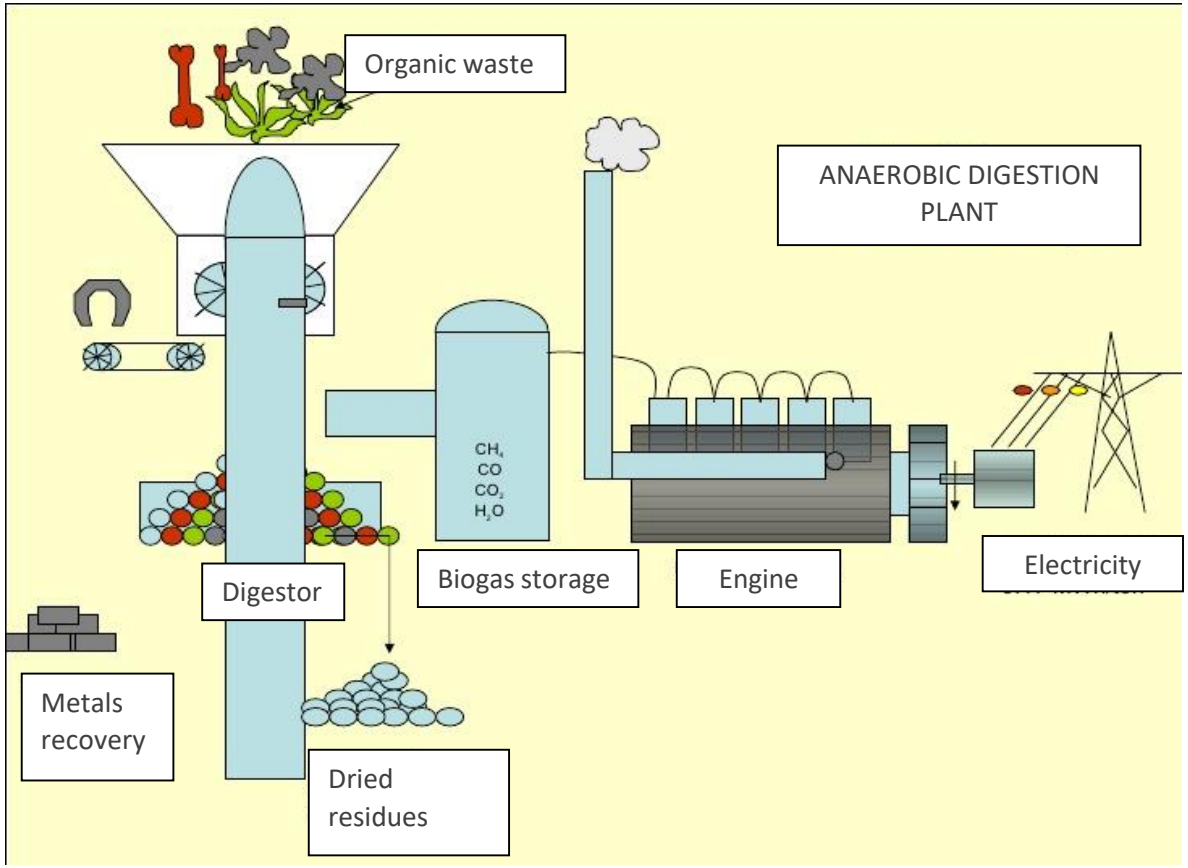


## Electricity from biogas – landfill extraction



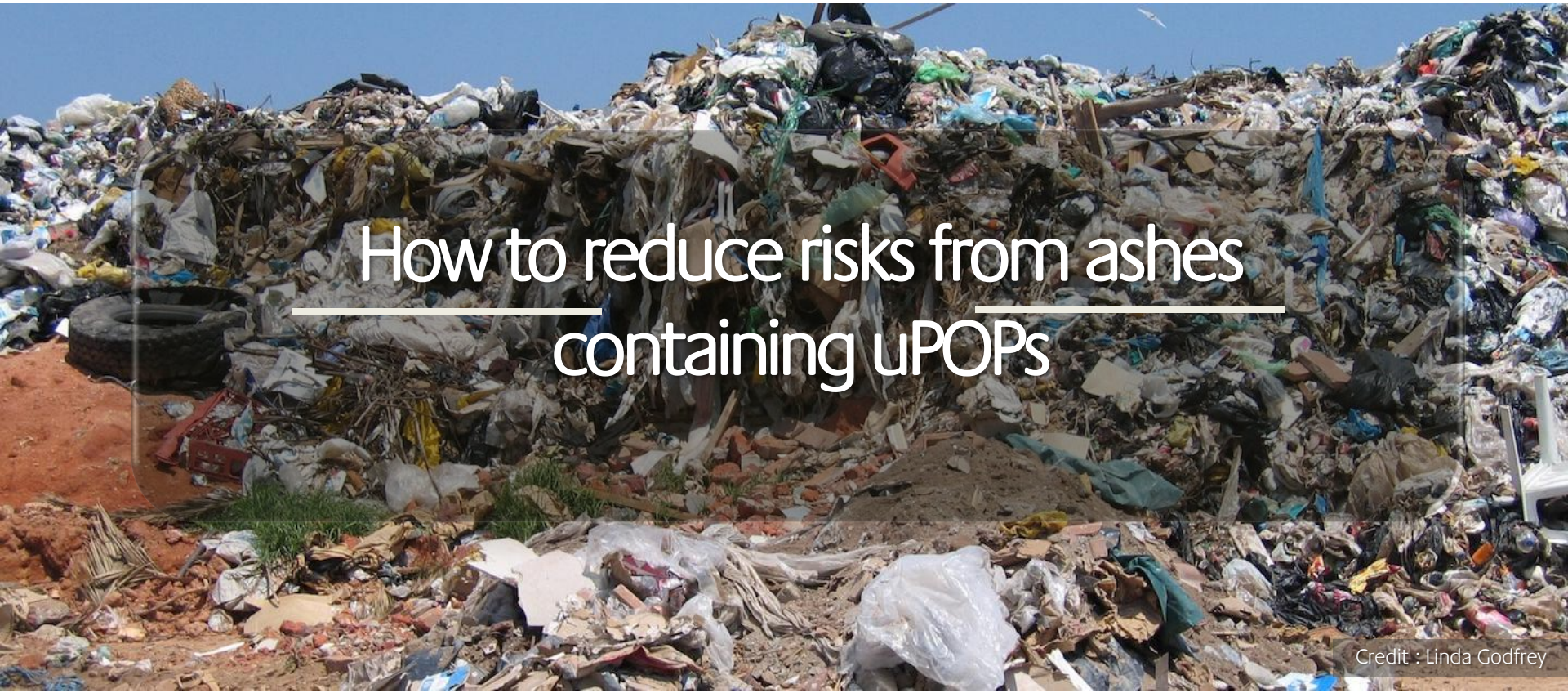

*1Schematic CNR Italy*

## Electricity from biogas - Anaerobic digestion/fermenting



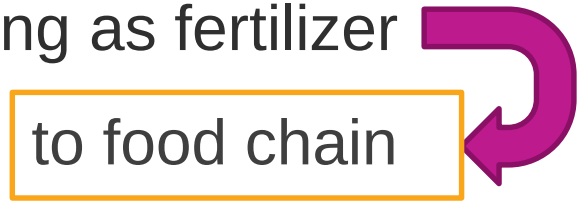

*1Schematic: CNR Italy*

# How to reduce risks from ashes containing uPOPs

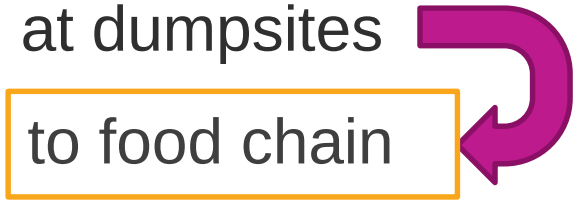


# Exposure from ashes with uPOPs

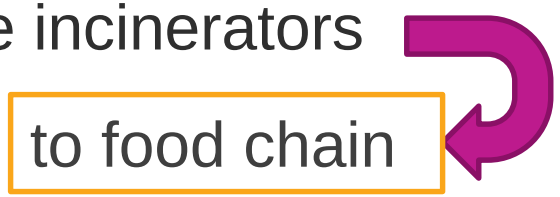
- Use of ash from waste burning as fertilizer




- Ingestion of ash and combusted materials by cattle, chicken, etc. grazing at dumpsites




- Disposal of ash from medical waste incinerators



# How to reduce risks from ashes containing uPOPs

- Awareness to people on risk of using ash from waste
- Estinguish fires as soon as detected
- Fencing dumpsite to stop animal grazing
- Safe disposal of ash produced by incinerators

# Best Practices and Techniques for Other Waste Types

# Hazardous waste and e-waste (electronics, etc.)

## When possible in your national setting:

- Separate hazardous waste and e-waste at source; for example
  - Mercury-added products (lamps, thermometers, button cell batteries, etc.)
  - Remains and packaging of pesticides, acids, disinfectant, etc.
  - Paints
  - Spent lubrification oils (from cars, etc.)
  - And many more

# Hazardous waste and e-waste (electronics, etc.)

- Secure environmentally safe separate collection, storage and treatment
- Haz waste treatment:
  - Ideally: treatment suited to each waste type: Final safe deposition of unusable toxic metals like mercury and cadmium, or secure and well operated/controlled incineration of organic hazardous waste
  - For some haz wastes, you need safe intermediate storage before export for treatment
  - As a minimum: create a specially secured deposit for hazardous waste, for example in a separately compartment of a sanitary landfill

# Hazardous waste and e-waste (electronics, etc.)

- Secure environmentally safe separate collection, storage and treatment
- E-waste treatment:
  - Dismantle in an environmentally sound manner
  - Direct usable, valuable fractions to environmentally sound recycling
  - Direct hazardous fractions (condensators, mercury-added lamps, etc.) to haz waste treatment

# Intentional Burning of Biomass

- Many agricultural residues such as cereals, straw are burned after harvesting;
- Logging of forest to produce charcoal generate emissions from residues burning;
- Cutting of forest to be replaced by plantations can result in open burning of residues;
- Practices to use the ash from bagasse boilers as fertilizer back to sugarcane fields can result in accumulation of POPs in the soil and in the product;

# Barriers to Elimination of Burning of Biomass

- Alternative uses to open burning, such as fuel for boilers may be not present in the area
- Alternative fuels for cooking to replace wood, such as LPG, are not spread in the country
- Use of residues from logging  for composting is not active at large scale
- Alternative use of ash from boilers might be not available

# Best Practices to Reduce Intentional Biomass Burning

- Use of agricultural residues as energy source in the food industry close to fields (sugar, palm oil processes);
- In field chipping, plowing down and composting residues to increase soil quality;
- Composting to produce high quality fertilizers from residues;
- Rotational logging of forest (for sustainability) and wood pellets production from residues – to be used for domestic and industrial use as fuels;

# Best Available Techniques to Burn Biomass

*3 Photo Massimo Gobbi*

*Photo Massimo Gobbi*

Biomass can be used as fuel in special grate boilers to produce heat / steam for industrial processes

# Plastic Film From Agriculture

*1Photo Massimo Gobbi*

Agricultural film is usually made from **polyethylene or ethylene-vinyl acetate copolymer (EVA)**; PVC (contains Chlorine) is less common today

Burning is common when no alternatives are offered to farmers

Distance from potential recyclers hinders recycling

Containers of pesticides (hazardous waste) may be present in in the material - needs proper disposal

# Best Practices for Agricultural Film Management

*1Photo Massimo Gobbi*

Possibly avoid burning it as fuel and prefer recycling

Organize centralized collection of worn plastic films in the areas where greenhouses are concentrated to economically handle large amounts;

Organize transport to recyclers (can be economic up to 500 km if baled);

Ensure separate safe treatment of pesticides containers (hazardous waste)

# Tyres

*Photo rinnovabili.it-Italy*

*Photo: Rinnovabili.it-Italy*

Tyres contain low concentrations of chlorine; they also contain significant Sulphur (inhibits formation of POPs)

Tyre market is growing in demand in the region

Lack of organized collection of worn tyres and lack of policies to encourage recycling is a cause of their abandonment in the environment

# Best Practices: Reuse of Worn Tyres

**Many application are available to reuse worn tyres:**

Retreading: Worn tyres are retreaded (refreshed pattern) to get new, lower priced tyres

Reuse as furniture, shoes, etc

*2Photo Oubilette magazin*

*2Photo Nonsprecare.it-Italy*

*2 Photo Tuttauto-Altervista-Italy*

*2Photo Costeniero gomme.it*

*2Photo: Riciclo Tutto-Italy*

# Best Practices for Tyres Recovery and Recycling

Set up a mandatory **Consortium** for collection and recycling of worn tyres among producers and dealers;

**Consortium** will collect tyres for free against a small tax on sale of new tyres

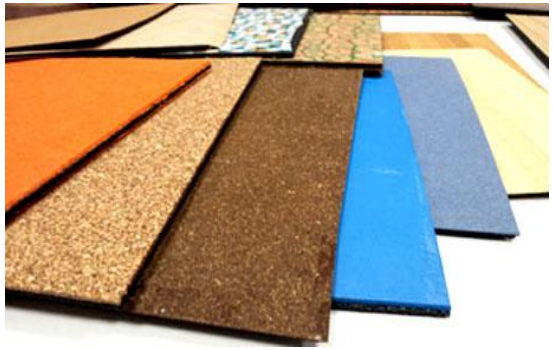
# Best Available Techniques for Tyres Recycling

Shredding and separation of rubber, steel, fabric; reuse as secondary materials for rugs and mats;

Use as fuel in cement kilns

Pyrolysis to produce fuel (liquid or gas):

*2Photo Sicurauto.it-Italy*



*2Photo Verdecologia-Italy*

*2 Photo ENEA -Italy*

# Construction and Demolition Waste

- Mainly consist of soil and inert matter; recyclables are recovered;
- Frequently abandoned along roads
- Limited legislative tools on management

- “Green Building”- Reuse for building foundations, bottom bed for roads, embankments, etc.
- Needs proper logistic: a site where waste can be crushed to be sold
- Legislative tools:  only licensed company can transport; system of mandatory receipts to evidence the final disposal of at dumpsites

# Flares and Oil Spills

*3 Photo Massimo Gobbi*

*4Photo Blueocean.net*

Particularly of concern is combustion of oil spilled on ground that contains salt or other chlorinated materials, or on seawater, or combustion of oil contaminated by intrusion of water into wells drilled near a saline body of water.

Emissions from oil/gas sector can be divided into two categories:

- Emissions from extraction/production activities ( gas flares)
- Burning of oil spills

# Best Practices to Reduce / Eliminate Flares and Oil Spills

*4 Photo MPR industries*

*4Photo EKU online-Eastern Kentucky University*

Install gas flares recovery systems

Conduct a risk assessment to identify weaknesses and improve reliability of extraction activities

Prevent oil spills to reach shores

# Intermediate Burning Technologies and Practices
# Medical (health-care) incinerators

# Intermediate Burning Technologies and Practices

Any form of combustion of waste which does not meet the standards for incineration

## Medical (health-care) incinerators

If they do not meet the standards, they turn out to be a source of emission of POPs

Phioto Massimo Gobbi

# Emission from Incinerators

(UNEP Toolkit 2013)

| Emission Factors (micrograms TEQ/t waste burned) | | |
|---|---|---|
| | Air | Residue (fly ash only) |
| Low technology combustion, no APCS | **35,000** | **9,000** |
| Controlled incineration with good APCS | **10** | **450** |

Mismanaged incinerators emit to air **3,500 times** more than good incinerators

# Causes of Mismanagement of Medical Waste Incinerators

uPOPs(dioxins/furans) are generated between 300°C and 800°C and destroyed over 900°C.
Low temperatures result in generation of uPOPs to air and residue

Phoito Massimo Gobbi

Photo Massimo Gobbi

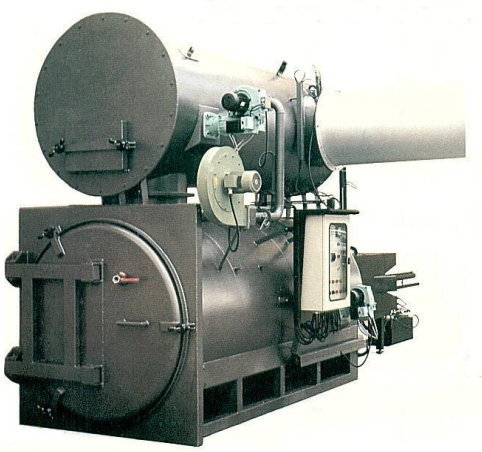
Phto Massimo Gobbi

| Low combustion temperatures originated from |
| --- |
| Loading of excessive quantities of waste in the furnace |
| Not optimized combustion air |
| Malfunctioning of burners |
| After burner turned off |
| Filter not cleaned |

# Best Practices to Reduce Emissions from Incinerators

- *Keep high temperatures (more than 900 °C) the core of the waste bags inside the furnace*
- *Keep the exhaust gas to more than 900 °C for more than 2 seconds before exit*
- *Check the ash; presence of products such as syringes indicates low temperatures*
- *Periodically clean filters*
- *Periodically check burners*
- *Use the waste feeding system to load the waste in the furnace*

# Best Available Techniques for Small Scale Medical Waste Incineration



*Pyrolitic incinerator Piroldi -Italy*

**Pyrolitic Type Incinerator**

Primary chamber with low air (oxygen) and low temperatures to avoid combustion (gasification)

Secondary chamber with high excess air (oxygen) and afterburner-T° 850-1100 °C.

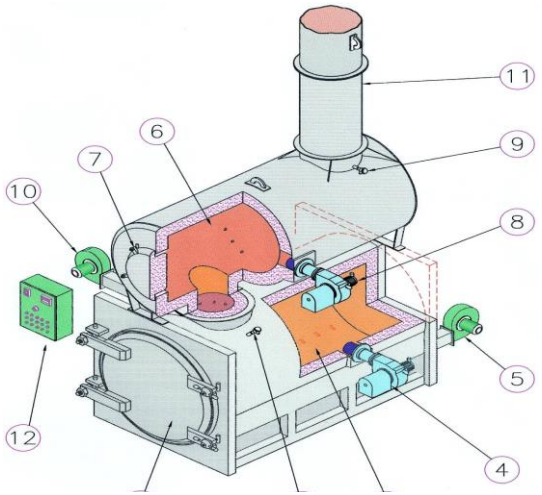
Batch operation, automatic mechanical feed of waste

Possibility of heat recovery

Bag filter

Additional filtering system, (not shown)

Dry type reactor with sodium bicarbonate




*4- schematic of a pyrolitic incinerator- Piroldi-Italy*

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# THANK YOU FOR YOUR ATTENTION!

Nelson Manda & Jakob Maag