

## Life cycle inventory for municipal solid waste management options

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FROM TRANSITIONAL ECONOMY TO SUSTAINABLE DEVELOPMENT  
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## Introduction

- Municipal waste managers are usually faced with the need of justifying existing and planned waste management options
- European Commission recognizes
  - ▶ strategic targets
    - for recycling rates
    - in terms of waste management options
  - ▶ the need of selecting management options taking into account the risks for environment and health

## Life cycle assessment utility

- Several models using life cycle assessment technique have been developed to
  - ▶ predict and compare the environmental impact of MSW management systems
    - by identification of environmental burdens
    - by advantages and disadvantages associated with different waste management scenarios

## Objectives of LCA in this study

- ▶ follow the consequences of waste management policy taken for the region through its environmental effects
- ▶ provide a preliminary data on the environmental consequences of two alternatives for treating organic matter in MSW
  - biogasification (anaerobic digestion)
  - composting (aerobic digestion)
- ▶ develop a life cycle inventory model for the region.

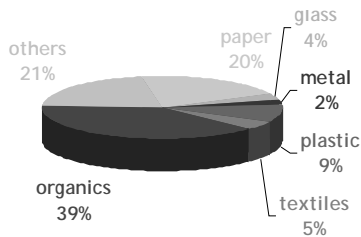
## Model and methodology

- Uses the model developed by White et al
- Quantifies energy consumption and greenhouse gases emissions
  - carbon dioxide, methane and nitrous oxide
- In one region similar to Porto city
  - ▶ population 300 000 inhabitants
  - ▶ production of 300 kg/person.year
- With this MSW collection system
  - ▶ during one year
  - ▶ commingled in plastic bags, every week days

## Operations included

- ▶ MSW collection and transport
  - Polyethylene production
- ▶ Landfill
  - Waste transport
  - Collection and gas burning
- ▶ Incineration
  - Electricity generation
  - Ash and fly ash transport to landfill
- ▶ Composting/Biogasification
  - Presort
  - Transport of presort residues to landfill
- ▶ Diesel, electricity and natural gas production and use
- ▶ Ferrous metals recovery

## MSW composition



## Scenarios 1 and 2

1. Landfilling
2. Incineration
  - energy recovery
  - 90% of ferrous metals recovered from bottom ash
  - ultimate residues are landfilled

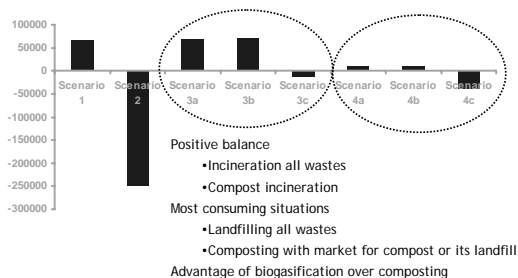
## Scenarios 3 - composting

- Presort of all wastes categories other than paper and organics
  - 90% of ferrous metals are recovered
- 3a. Composting of paper and organics; **market** for the compost produced
  - 3b. Composting of paper and organics; **compost landfilling**
  - 3c. Composting of paper and organics; **compost incineration**
- Landfilling of sorting residues

## Scenarios 4 - biogasification

- Presort of all wastes categories other than paper and organics
  - 90% of ferrous metals are recovered
- 4a. Biogasification of paper and organics; **market** for the compost produced
  - 4b. Biogasification of paper and organics; **compost landfilling**
  - 4c. Biogasification of paper and organics; **compost incineration**
- Landfilling of sorting residues

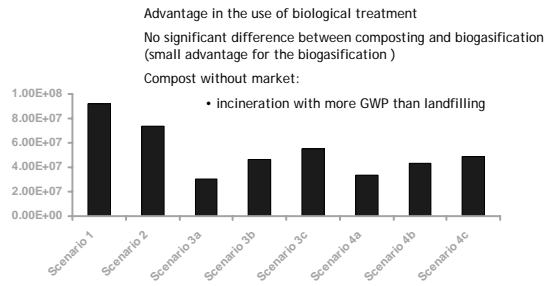
## Energy consumption (GJ)



## Global warming potential

- greenhouse gases emissions are aggregated using global warming potential weighting factors according to the recommendations of the Intergovernmental Panel on Climate Change
  - ▶ Carbon dioxide: 1
  - ▶ Methane: 21
  - ▶ Nitrous oxide: 310

## Global warming potential



## Conclusions

- ▶ Energy
  - Clear advantage of MSW incineration over others
  - Advantage of biogasification over composting
  - Some advantage on compost incineration when it is not marketable
- ▶ Global warming potential
  - Advantage of biological treatment, shortened when compost is not marketable