

## The effect on the GHG emissions of MSW management practices based on EU legislation targets

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## Introduction

- Waste management in developed countries is governed by legislation
- European Commission recognizes
  - ▶ end-of-pipe regulations
    - Incineration (89/369/EC, 89/429/EC, 2000/76/EC)
    - Landfill (99/31/EC)
  - ▶ strategic targets
    - in terms of waste management options
    - recycling rates (94/62/EC)
  - ▶ the need of selecting management options taking into account the risks for environment and health

- ▶ Landfill directive (99/31/EC)
  - Biodegradable (paper, cardboard, food, organic garden waste) municipal solid waste landfilling must be reduced to 75% by 2006 (compared to 1995 levels),
  - dropping to 50% by 2009 and 35% by 2016
  - Member states that landfill over 80% of their MSW may postpone these targets by a period not exceeding 4 years
- ▶ Packaging and packaging waste directive (94/62/EC)
  - Target 1
    - Recovery (recycling, energy recovery, biological treatment) level of between 50% and 65% by weight of all packaging waste
      - » Portugal, Greece, Ireland (25% Dez. 2001, 50% Dez. 2005)
  - Target 2
    - Recycling level of between 25% and 45% by weight of all packaging waste
      - » Portugal, Greece, Ireland (25% Dez. 2005)
  - Target 3
    - Minimum recycling level of 15% for each material type (paper, plastic, metal and glass)

## Porto: a story

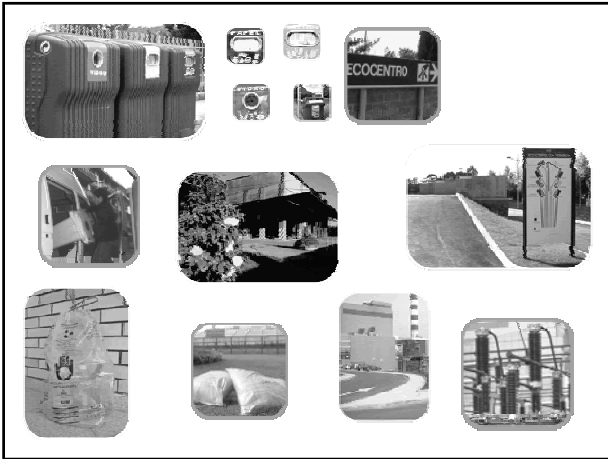


## Porto - population and waste

1990	2000
• 302 500 inhabitants	• 280 000 inhabitants
• 383 kg/person/year	• 518 kg/person/year
• Collection <ul style="list-style-type: none"> <li>▶ Kerbside mixed                             <ul style="list-style-type: none"> <li>• Bags</li> <li>• Containers</li> </ul> </li> <li>▶ Glass banks</li> </ul>	• Collection <ul style="list-style-type: none"> <li>▶ Kerbside mixed                             <ul style="list-style-type: none"> <li>• Bags and Containers</li> </ul> </li> <li>▶ Kerbside dry recyclables                             <ul style="list-style-type: none"> <li>• Paper/cardboard, packages</li> </ul> </li> <li>▶ Central collection sites</li> <li>▶ Collection banks</li> </ul>
• Treatment methods <ul style="list-style-type: none"> <li>▶ Composting</li> <li>▶ Landfill</li> <li>▶ Recycling of glass</li> </ul>	• Treatment methods <ul style="list-style-type: none"> <li>▶ Composting</li> <li>▶ Incineration</li> <li>▶ Landfill</li> <li>▶ Recycling (glass, plastic, paper)</li> </ul>

## Porto - waste composition

1990	2000
• PA - 21.9%	• PA - 20.9%
• G - 4.1%	• G - 4.2%
• M - 2.8%	• M - 1.5%
• PI - 8.5%	• PI - 11.4%
• Te - 3.9%	• Te - 2.7%
• OR - 35.6%	• OR - 35.7%
• Ot - 23.3%	• Ot - 23.7%



## Life cycle assessment

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

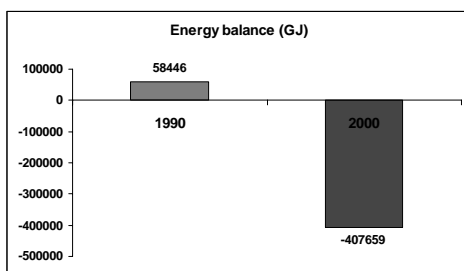
## Objectives

- ▶ follow the consequences of waste management policy taken for the region through its environmental effects
- ▶ provide a preliminary data on the environmental consequences of the alternatives for treating MSW
- ▶ development of a life cycle inventory model for the region.

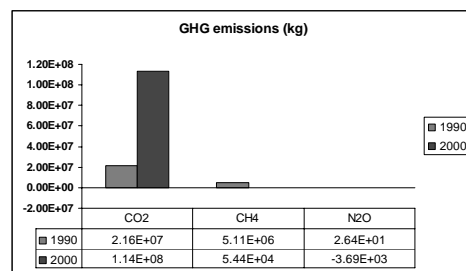
## Model and methodology

- model developed by White et al
- quantification of energy consumption and greenhouse gases emissions
  - carbon dioxide, methane and nitrous oxide
- MSW collected
  - ▶ during one year

## Energy balance (GJ)

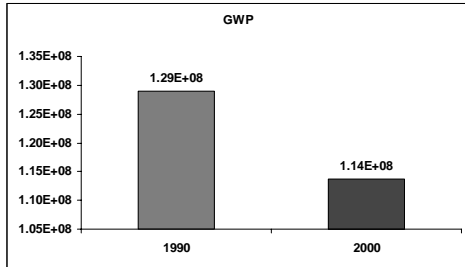


## GHG emissions (kg)

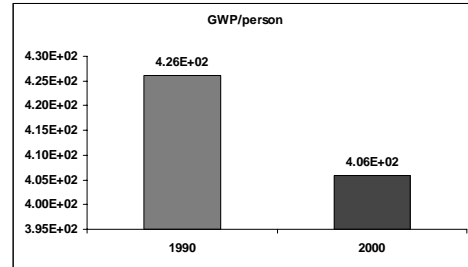


## GWP

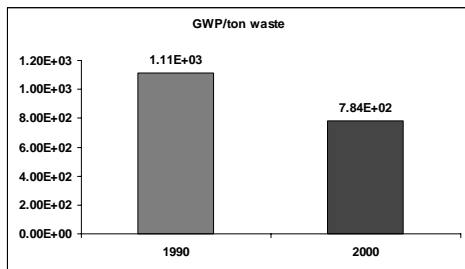
(Carbon dioxide: 1, Methane: 21, Nitrous oxide: 310  
Intergovernmental Panel on Climate Change)



## GWP (/person)



## GWP (/ton waste)



## Conclusions

- ▶ Energy
- ▶ Global warming potential

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