

Evaluation of MSW management practices in Portugal using *Life Cycle Assessment*

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1st BOKU Waste Conference
April, 4 - 6, Vienna, Austria



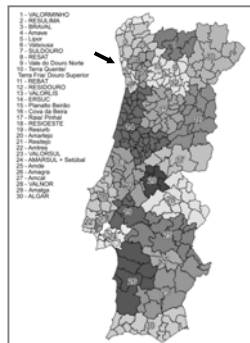
Objective

- Evaluate environmental burdens associated with MSW management practices
 - from collection to final disposal
 - 1990 vs 2000
 - 3 municipalities
 - Porto
 - Maia
 - Gondomar
 - LCI model from P&G
 - Emissions of GHG
 - Energy consumption



MSW management in Portugal

- Responsibility of municipalities
- 30 associations
 - Optimization of infrastructures investment
 - Operation cost reduction



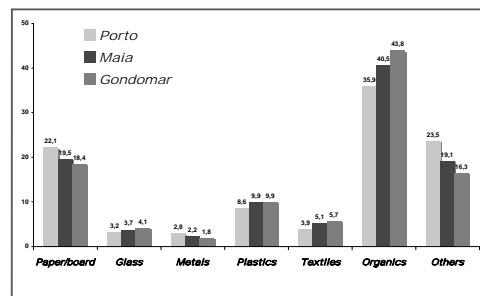
MSW management in Portugal

- LIPOR
 - Committed to manage the MSW of 8 municipalities in the Porto region
 - Porto - 43 km²
 - Maia - 77 km²
 - Gondomar - 137 km²
 - MSW collected by the municipalities and transported to LIPOR treatment sites



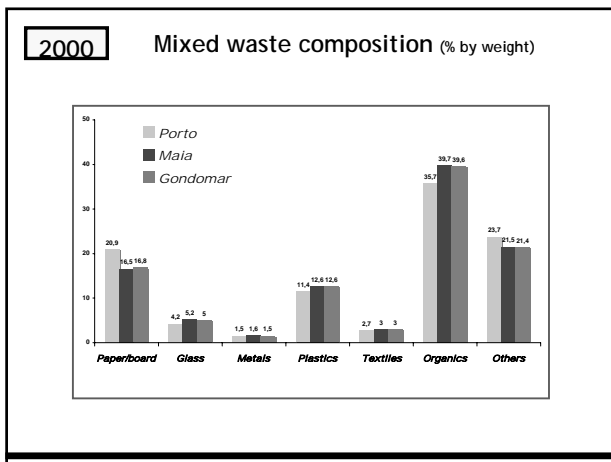
1990	Porto	Maia	Gondomar
Population	302 500	93 000	143 200
Hab/household	2,7	3,1	3,1
MSW production (kg/person/year)	383	287	208
Collection	Kerbside collection of mixed waste		
	6 x week 115 000 ton	2 x week 26 600 ton	2 x week 29 600 ton
	Glass banks		
	1 050 ton	109 ton	168 ton
Disposal	Composting: 20% <ul style="list-style-type: none"> Recovery of 6% Fe metals and 16% non-ferrous Compost marketed Residual waste to landfill 		
	Landfilling: 80% <ul style="list-style-type: none"> Gas collection system Lined Leachate collection and treatment 		
	Glass Recycling		

1990 Mixed waste composition (% by weight)



2000		Porto	Maia	Gondomar
Population		263 100	120 100	164 100
Hab/household		2,1	2,5	2,5
MSW production (kg/person/year)		551	410	391
Collection	Kerbside collection of mixed waste			
		6 x week	5 x week	6 x week
		96,4%	93,0%	97,8%
		Selective collection		
	Door-to-door: paper/board, packages			
	Collection banks: paper/board, packages, glass			
	Central collection sites: paper/board, plastic, glass			
Packages		6,6% (2% DTD)	24,6% (87% DTD)	8,0% (76% DTD)
Paper/board		36,8% (1% DTD)	37,5% (21% DTD)	23,7% (49% DTD)
Glass		54,2%	27,5%	62,4%
Plastics		2,4%	10,4%	5,9%

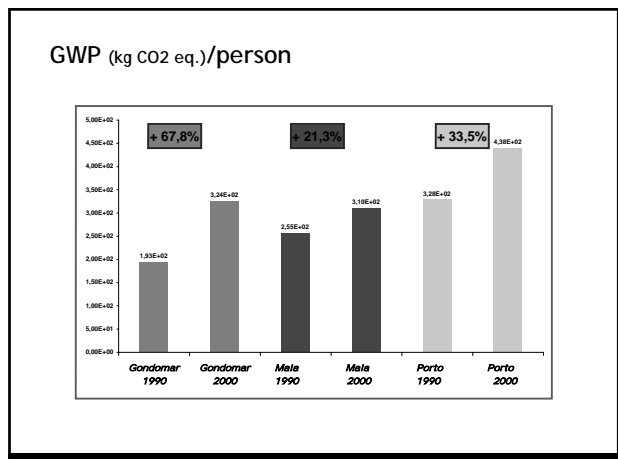
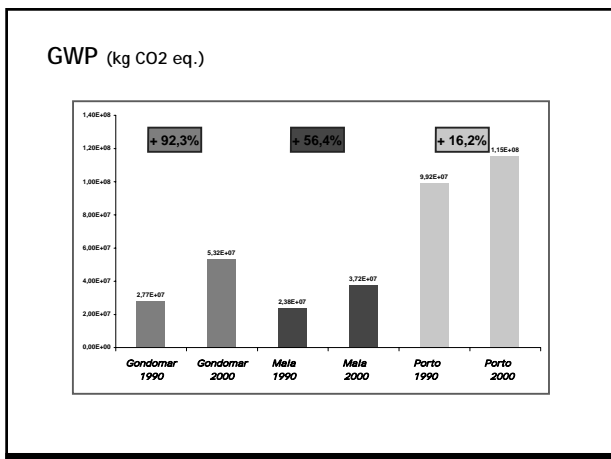
2000		Porto	Maia	Gondomar
Disposal	Central Sorting			<ul style="list-style-type: none"> Electrical energy consumption: 30,7 kWh/ton waste Diesel consumption: 2,17 L/ton waste Residual waste to incineration plant 15 km away
	Composting	19,7%	23,1%	1,4%
				<ul style="list-style-type: none"> Recovery of ferrous scrap from bottom ash: 100% Compost marketed Residual waste to landfill 15 km away
	Incineration	79,2%	75,8%	95,4%
				<ul style="list-style-type: none"> Mass-burn with energy recovery Efficiency of electricity production: 20% Recovery of ferrous scrap from bottom ash: 90% Non-hazard waste to landfill 15 km away Fly ash to a landfill 300 km away
Landfilling	1,1%	1,2%	3,2%	
			<ul style="list-style-type: none"> Diesel consumption: 0,6L/ton waste Gas collection system (40% efficiency) + burned Lined Leachate collection (70%) and treatment 	



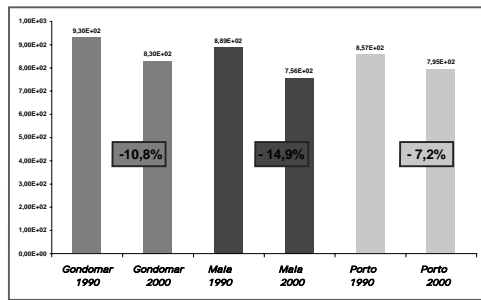
Results

- Global Warming Potential (GWP)*
 - kg CO2 eq.
 - GWP/person
 - GWP/ton waste
- Net energy use
 - GJ
 - GJ/ton waste
 - GJ/person

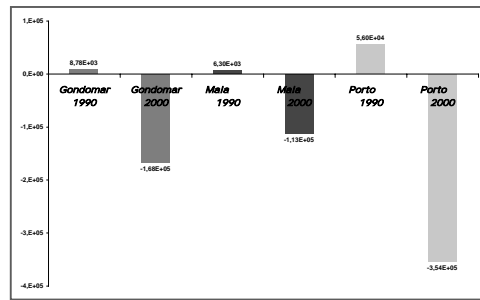
* Carbon dioxide: 1
Methane: 21
Nitrous oxide: 310



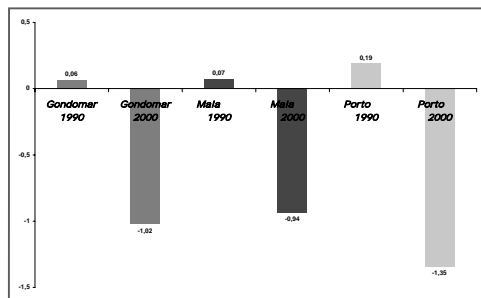
GWP (kg CO2 eq.)/ton waste



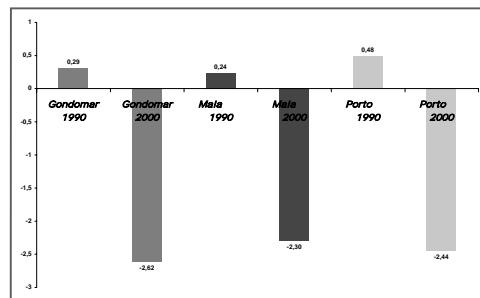
Net Energy Use (GJ)



Net Energy Use (GJ)/person



Net Energy Use (GJ)/ton waste



Conclusions

- GWP (2000) > GWP (1990) - all municipalities
- Highest increase GWP - Gondomar
- Lowest increase GWP - Porto
- GWP/person - 1990
 - ▶ Porto > Maia > Gondomar
- GWP/person - 2000
 - ▶ Porto > Gondomar > Maia
- GWP/ton waste (2000) < GWP/ton waste (1990) - all municipalities
 - ▶ 1990: Gondomar > Maia > Porto
 - ▶ 2000: Gondomar > Porto > Maia
- Energy consumption/production proportional to waste amount
- Frequency of waste collection with an higher impact in 1990

Acknowledgements

- LIPOR
 - ▶ Fernando Leite, Nuno Barros, Susana Lopes
- Maiambiente
 - ▶ Carlos Mendes
- CM Gondomar
 - ▶ Osvaldo Figueiredo
- CM Porto
- FCT - Fundação para a Ciência e a Tecnologia

Thank you