

# ENERGY FROM WASTE IN PORTUGAL: THE STATE OF THE ART



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## ABSTRACT

The objective of this paper is to present an overview of the solid waste incineration in Portugal. Both municipal, industrial, health care and biomass wastes are considered. For each type of waste it is firstly presented information on the production and final destination and after that the identification and characterization of the incineration units. It was concluded that the incineration process plays an important role in the waste management sector and has a great potential to expand.



### Municipal Solid Waste (MSW)

#### MSW production (2005)

**Continental Portugal**  
• 4.7 millions of tons, about 475 kg/hab.year (1.3 kg/hab.day)

**Archipelago of Azores**  
• 132 335 tons, about 554 kg/hab.year

**Archipelago of Madeira**  
• 163 850 tons, 5 679 Kg/hab.year

The higher production of MSW occurs in the region of Lisbon and in the North. This is due to the population density and high concentration of economical activities.

#### MSW final destination (2005)

In 2005 the main final destination of MSW from Continental Portugal was the landfill (63%), followed by incineration (21%), selective collection (9%) and composting (7%).

**Autonomous regions**

In Archipelago of Azores (AA) the landfill was also the main destination of MSW and in Archipelago of Madeira (AM) incineration was the destination of 71% of MSW.

#### MSW incineration units

In Portugal exist three MSW incineration plants associated to the municipal management systems operating in Porto, Lisbon and Madeira.

#### Lipor – Sistema Intermunicipalizado de Gestão de Resíduos do Grande Porto

- Created as Municipalities Association in 1982
- Includes eight municipalities
- Around 1 million of inhabitants
- MSW global production: 500 000 t/year
- MSW production per capita: 1.4 kg/hab.day
- 2006:
  - Reception of 362 470 t of MSW to incineration
  - Production of electric energy: 181 175 MWh

Combustible	Municipal solid waste
Process	Mass burning with energy recovery
Plant capacity	
Nominal treatment capacity (for PCI of 7700 kJ/kg)	380 000 t/year
Capacity of reception	18 000 m <sup>3</sup> (60000 t)
Electric energy production	25 MWh
Process line	
Discharge	13 dump points
Line numbers	2
Combustion	2 sloped combustion grates (20P from the horizontal line), 4 bottom ashes extractors, 3 tanks for rejected material (bottom ashes and furnace scories)
Gases treatment	2 reactors, 2 sleeve filters, chimney of 68 meters high

#### Valorsul, S.A.

- Created in September of 1994
- Treatment and valorization of about 750 000 tons of MSW per year
- Includes five municipalities

Combustible	Mixed MSW from municipalities or individuals
Process	Mass burning with energy recovery
Total area	4 ha
Nominal treatment capacity	662 000 t per year (90% of availability)
Wastes Lower Heating Value (LHV)	Nominal - 7820 kJ/kg, Minimum - 5860 kJ/kg, Maximum - 10460 kJ/kg
Furnace grate	Detrit Stoker Reverse-Acting Stoker
Processing capacity	28 t/h per line 3 lines installed and another one foreseen
Exploitation regime	24 hours/day, 365 days/year
Boilers	3 units with natural circulation (water panel with superheating)
Total electricity production	587 MWh per ton of MSW (for nominal LHV)
Electric consumption	89 kWh per ton of MSW (for nominal LHV)
Combustion products (per ton of MSW)	200 kg of bottom ashes (they can be used as inert for construction, public works and eventually for landscape recovery of stone quarry and mines) 30 kg of ashes and residues of treatment of the de gases (Solidified/neutralized and further landfilled) Ferrous and non ferrous metals recovery.
Gases treatment	Nitrogen oxides, acid gases, dioxines, heavy metals, particles removal system

#### Valor Ambiente Gestão e Administração de Resíduos da Madeira, S.A.

- Labour start: 6<sup>th</sup> August, 2002
- Includes 11 municipalities
- 2005:
  - Total population: 241 257 inhab.
  - Input waste: 112 750 t
  - Residues produced:
    - Fly ashes: 8 034 t
    - Bottom ashes: 22 024 t

Combustible	Municipal solid waste
Process	Mass burning with energy recovery
Grate	LENZES Rostfeuerungungen GmbH - "tolos"
Total area	42 500 m <sup>2</sup>
Incineration capacity	2 x 8 t/h
Nominal processing capacity	126 000 t/year (90% of availability)
Wastes Lower Heating Value (LHV)	Nominal - 7 500 kJ/kg
Exploitation regime	24 hours/day during 8000 hours/year
Boilers	2 units
Vapor flow turbine	19.44 t/hour
Electricity production	473 MWh MSW
Number of households supplied by energy produced	23 000
Bottom ashes sent to landfill	160 kg MSW
Residues from gases treatment system	69 kg MSW

#### Industrial waste production (2002)

In 2002 it was produced in Portugal about 13 x 10<sup>6</sup> t of Industrial Waste. From this 187 000 t were hazardous waste, about 1.4% of the total industrial waste production.

**Production of industrial waste by sector**

- Extractive industries
- Transforming industries
- Housing and catering
- Industrial activities not specified
- Production and distribution electricity, gas and water
- Non-hazardous industrial waste (NHZ)
- Hazardous industrial waste (HZ)
- Not specified industrial waste (NSIW)

#### Final destination of Industrial waste (2002)

**Final destination of non-hazardous (NHZ) and hazardous (HZ) industrial waste**

**Final destination of industrial waste**

- Elimination
- Recovery
- Not specified
- Landfill
- Incineration
- Incineration with energy recovery
- Recycling

#### Industrial Waste incineration units

- Secil – Companhia Geral de Cal e Cimento, S.A.**  
Activity: cement manufacture  
License to energy recovery non hazardous industrial waste since 26<sup>th</sup> June 2005 and license for recovering hazardous waste since 27<sup>th</sup> October 2006  
Hazardous waste recovered: oils sludge, oils and solvents  
Amount of waste received (2006): 65 414 t  
Amount of waste received (2006): 60 685 t
- CMF – Cimentos Maceira e Pataias, S.A. (unit of Maceira – Liz)**  
Activity: cement manufacture  
License for co-incineration of used tires (code 16 01 03)  
Waste recovered: The used tires are the only waste used as alternative fuel that is under the scope of Directive 2000/76/CE  
Amount of waste received (2006): 12 103 t  
Amount of waste received (2006): 12 510 t
- Recauchutagem Nortenha, S.A. – Unit of energy recovered**  
Activity: electricity production  
License for management of used tires and others rubber wastes under the scope of Directive 2000/76/CE (codes - 07 02 99, 16 01 03, 19 12 04)  
Amount of waste received (2006): 11 009 443 t

#### Health Care production (2005)

**Classification of health care waste in accordance with Despacho nº 242/96 from 5<sup>th</sup> July**

In Continental Portugal production of health care waste was 54 667 649 kg.

- Group I** – MSW and similar – they do not present special treatment requirements
- Group II** – non-hazardous waste – they are not submitted to specific treatment, being able to be managed by MSW systems
- Group III** – wastes with biologic risk – contaminated waste or suspected of contamination, susceptible of incineration or disinfection allowing posterior elimination as MSW
- Group IV** – specific health care waste – wastes that must be incinerated

#### Management options for health care waste (2005)

Wastes from group I and II are considered non-hazardous and do not require special treatment. They are considered similar to MSW and enter the normal flow stream of this waste type.

**Amount of waste by treatment method (in kg)**

Treatment method	Group III	Group IV	Total
Incineration	2 000	742 737	744 737
Exported		1 000 054	1 000 054
Chemical disinfection	95 000		95 000
Autoclaving	16 006 256		16 006 256
Total	16 103 256	1 742 791	17 846 047

#### Health Care incineration unit

The Health care incineration unit of the Parque da Saúde in Lisbon was the first unit in the country and the only one in the Continental Portugal able to process health care waste from group IV.

**Health Care waste incineration unit from Parque da Saúde**

The exploitation and maintenance of the Health care waste incineration unit belongs to SUCH – Service of Common Use of Hospitals, since 1996.

#### Biomass waste power plants

In Portugal exist:

- Two biomass power plants connected to the electric grid using forest biomass as main fuel:
  - EDP unit in Mortágua
  - Centroliva in Vila Velha de Rodão
- Nine units of co-generation installed in industries from the forest sector that use biomass for heat production:
  - Portugal Industrial, S.A.
  - Amorim Revestimentos, S.A.
  - Portugal Tejo, S.A.
  - Stora Celbi, S.A.
  - Soporcel
  - Comp. S de Celulose do Calma, S.A.
  - Portugal Industrial, S.A. (Setúbal)
  - Portugal Viana, S.A.
  - SIAF

#### Characteristics of forest biomass power plants

**Rodão**

- Nominal power: 14.4 MVA
- Energy production: 80 GWh/year
- Combustion technology: Fluidized bed
- Biomass consumption: 160 000 t/year
- Starting date: 2001

**Mortágua**

- Installed power: 9 MW (10 MVA)
- Generation potential: 60 GWh
- Annual production at full load: 67 GWh
- Biomass consumption with 30% humidity: 8.7 t/hour
- Biomass annual consumption: 109 000 t
- Lower Heating Value (LHV): 13 800 kJ/kg
- Fuel park capacity: 55 000 m<sup>3</sup>
- In operation since: August 1999

#### New biomass units

In February of 2006 the government launch a consultation for the construction of 15 new forest biomass incineration plants in regions with increased fire risk and abundance of forest waste including 12 districts mainly from the center of the country. It had been attributed 100 MW of power in an total investment of 250 million euros. Two types of units were considered:

- Up to 12 MW, allowing scale economy in the electric energy production and assuring a biomass collection from distant regions
- Up to 6 MW, allowing the development of small local units in the perspective of local development.

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