ENERGY FROM WASTE IN PORTUGAL:
the state of the art

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ABSTRACT

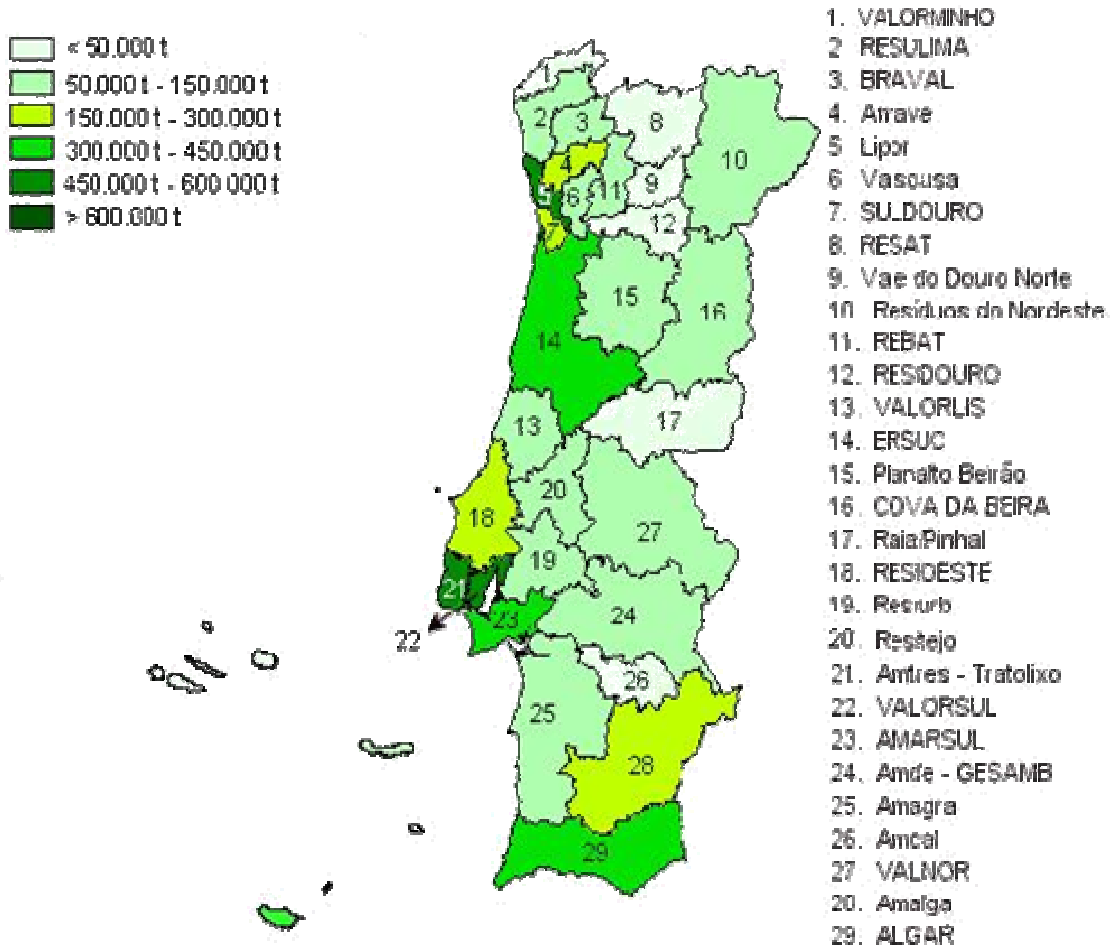
- Overview of the solid waste incineration in Portugal
  - **Municipal**
  - **Industrial**
  - **Health care**
  - **Biomass wastes**

- For each type of waste
  1. **information on the production and final destination**
  2. **identification and characterization of the incineration units**

Municipal Solid Waste

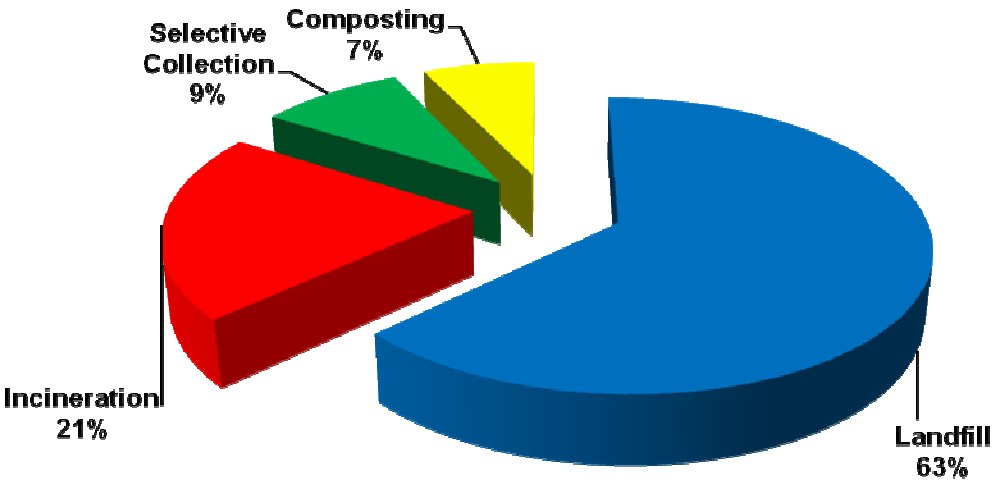
MSW production (2005)

- **Continental Portugal**
  - 4.7 x 10^6 t
  - 475 kg/hab.year
  - 1.3 kg/hab.day
- **Archipelago of Azores**
  - 132 335 t
  - 554 kg/hab.year
- **Archipelago of Madeira**
  - 163 850 t
  - 679 kg/hab.year

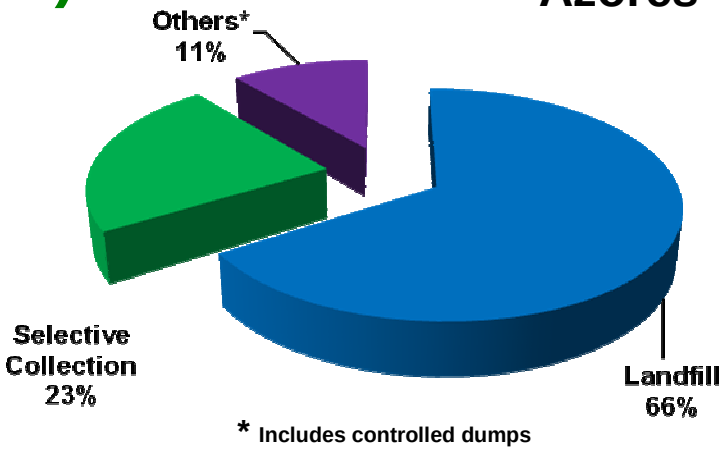


MSW final destination (2005)

Continental Portugal

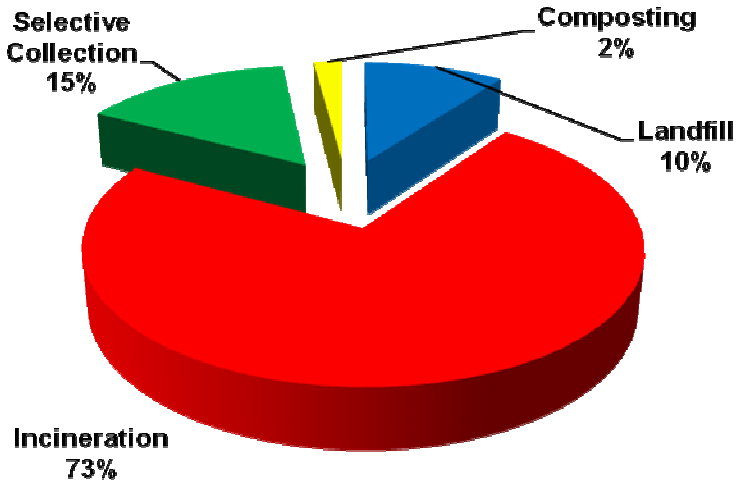


Azores



* Includes controlled dumps

Madeira



Municipal Solid Waste

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incineration plants

LIPOR

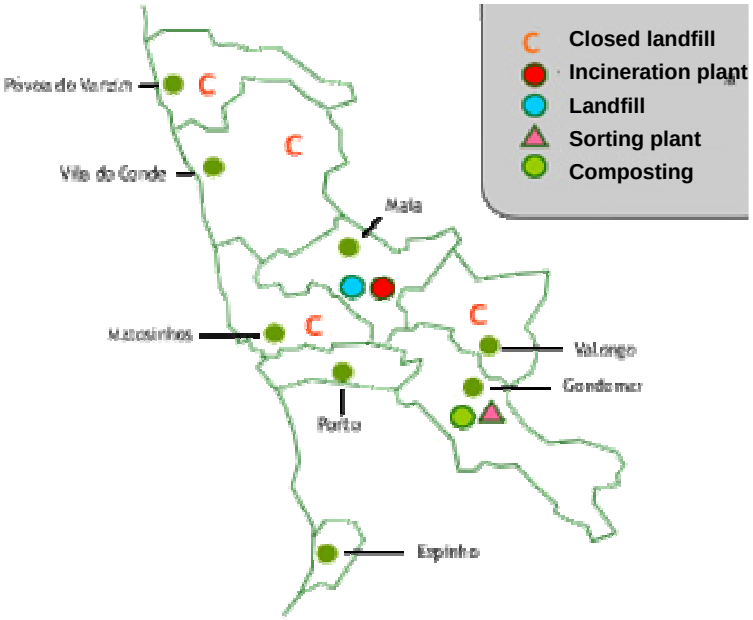
VALORSUL

VALOR AMBIENTE

LIPOR

Sistema Intermunicipalizado de Gestão de Resíduos do Grande Porto

- created as association of municipalities in 1982
- 8 municipalities
- 1 million inhabitants
- influence area 650 km^2



- **MSW global production:** 500 kt/year

  1.4 kg/hab.day

- **Incineration in 2007:**
  - 420 kt mixed MSW
  - production of about 212 GWh electric energy

LIPOR - Main characteristics of MSW incineration plant

Mass burning with energy recovery

Plant capacity

- ✓ Nominal treatment capacity: 380 kt/year
- ✓ Reception capacity: 18 000 m^3 (6000 t)
- ✓ Electric energy production: 25 MWh

Process line

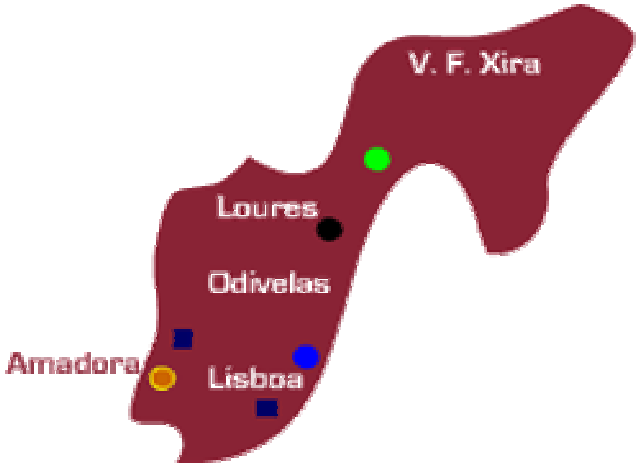
- ✓ Discharge: 13 dump points
- ✓ Line numbers: 2
- ✓ Combustion:
  - 2 sloped combustion grates (26º from the horizontal line)
  - 4 bottom ashes extractors
  - 3 tanks for rejected material (bottom ashes and ferrous scraps)
- ✓ Gases treatment:
  - 2 reactors
  - 2 sleeve filters
  - chimney of 68 meters high

VALORSUL

- created in 1994
- 5 municipalities
- 1.2 million inhabitants
- influence area 596 km^2

- **MSW global production:** 750 kt/year

- **Incineration in 2007:**
  - 482 kt mixed MSW
  - production of about 290 GWh electric energy



- **Landfill**
- **Incineration plant**
- **Biowaste valorization plant**
- **Sorting plant**
- **Voluntary bring systems, selective containers, dumps**

VALORSUL - Main characteristics of MSW incineration plant

Mass burning with energy recovery

Plant capacity

- ✓ Nominal treatment capacity: 662 kt /year (90% of availability)
- ✓ Wastes Lower Heating Value (LHV): Nominal - 7820 kJ/kg
- ✓ Total electricity production: 587 kWh per ton of MSW (for nominal LHV)

Process line

- ✓ Processing capacity: 28 t/h per line (3 lines installed and another one foreseen)
- ✓ Furnace grate: Detroit Stoker Reverse-Acting Stoker
- ✓ Boilers: 3 units with natural circulation (water panel with superheating)
- ✓ Electricity consumption: 89 kWh per ton of MSW (for nominal LHV)
- ✓ Combustion products (per ton of MSW):
  - 200 kg of bottom ashes
  - 30 Kg of ashes and residues form gases treatment
- ✓ Gases treatment: Nitrogen oxides, acid gases, dioxines, heavy metals, particles removal system

VALOR AMBIENTE

Gestão e Administração de Resíduos da Madeira, S.A.

- 11 municipalities
- 241 000 inhabitants
- influence area 741 km^2

- **MSW global production:** 173 kt/year

- **Incineration in 2007:**
  - 120 kt mixed MSW
  - production of about 52 GWh electric energy

VALOR AMBIENTE - Main characteristics of MSW incineration plant

Mass burning with energy recovery

Plant capacity

- ✓ Nominal processing capacity: 126 kt/year (90% of availability)
- ✓ Wastes Lower Heating Value (LHV): Nominal - 7500 kJ/kg
- ✓ Electric energy production: 473 kWh per ton of MSW

Process line

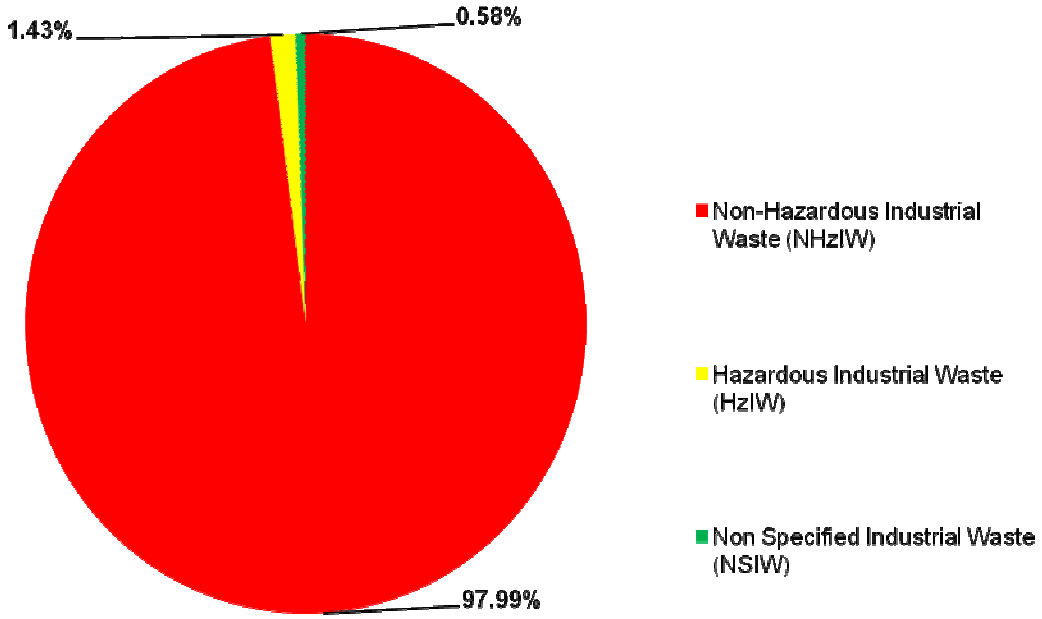
- ✓ Incineration capacity: 2 x 8 t/h
- ✓ Grate: LENTJES Rostfeuerungen
- ✓ Boilers: 2 units
- ✓ Vapor flow turbine: 19.44 t/h
- ✓ Number of households supplied by energy produced: 23 000
- ✓ Bottom ashes sent to lanfill: 160 kg/t MSW
- ✓ Residues from gases treatment system: 59 kg/t MSW

Industrial Waste

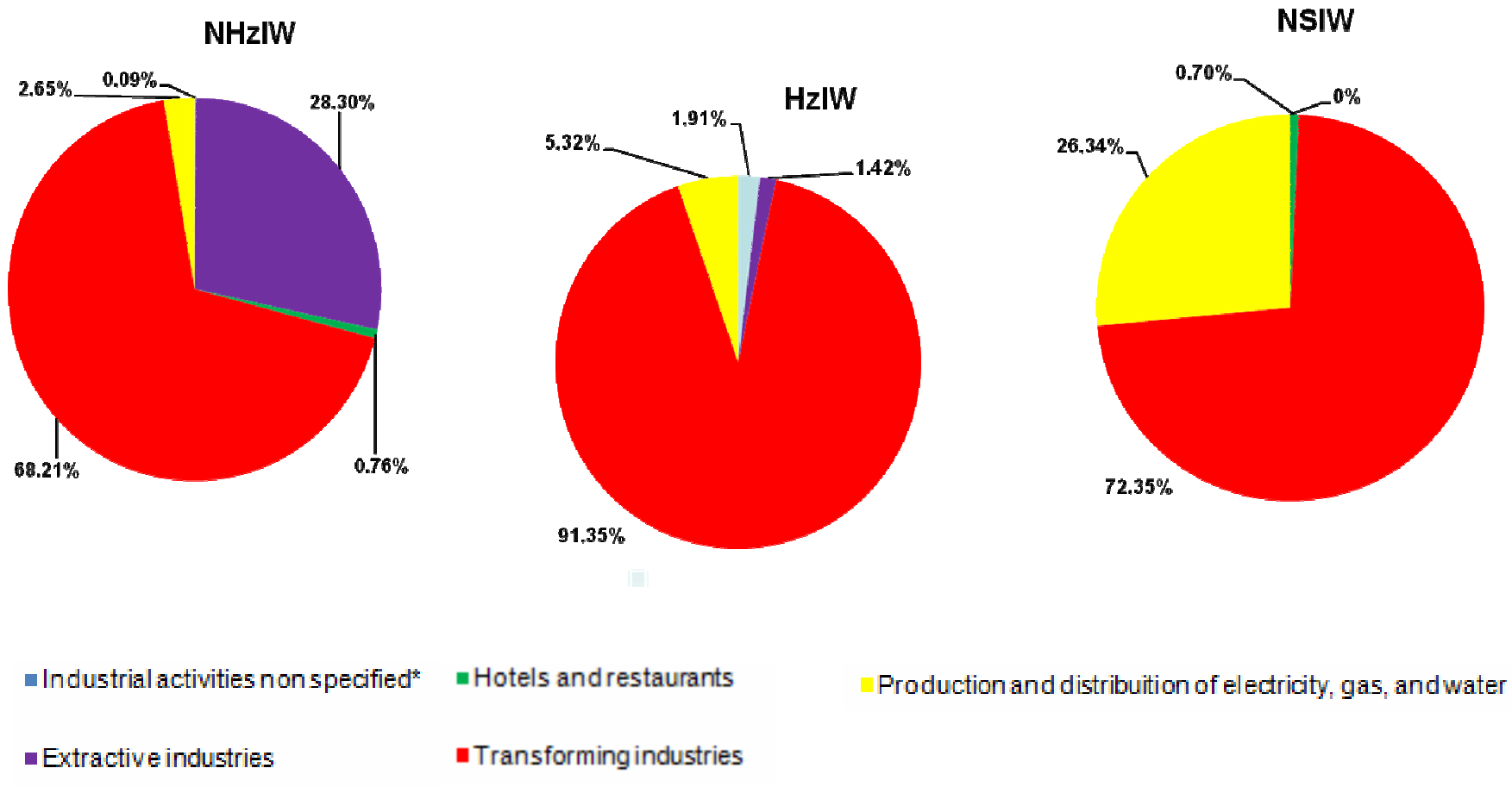
Industrial waste production (2002)

13 000 kt of Industrial Waste

- 187 kt hazardous waste = about 1.4% of the total industrial waste production

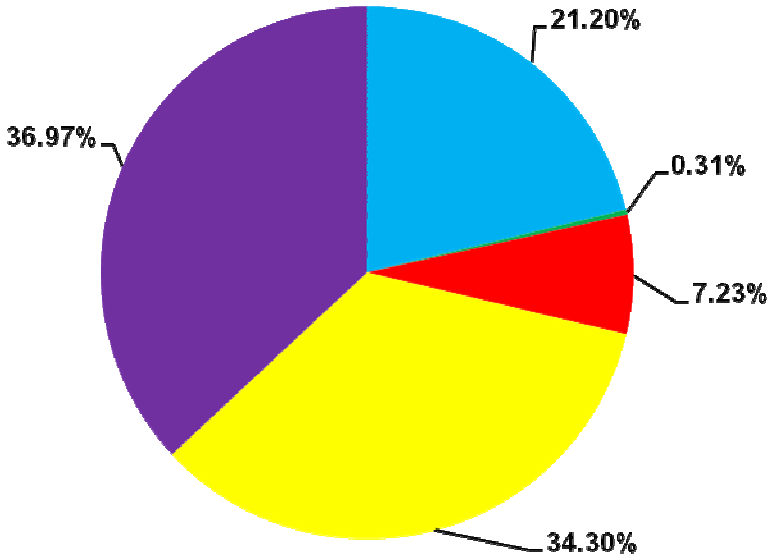


Industrial waste production by sector (2002)

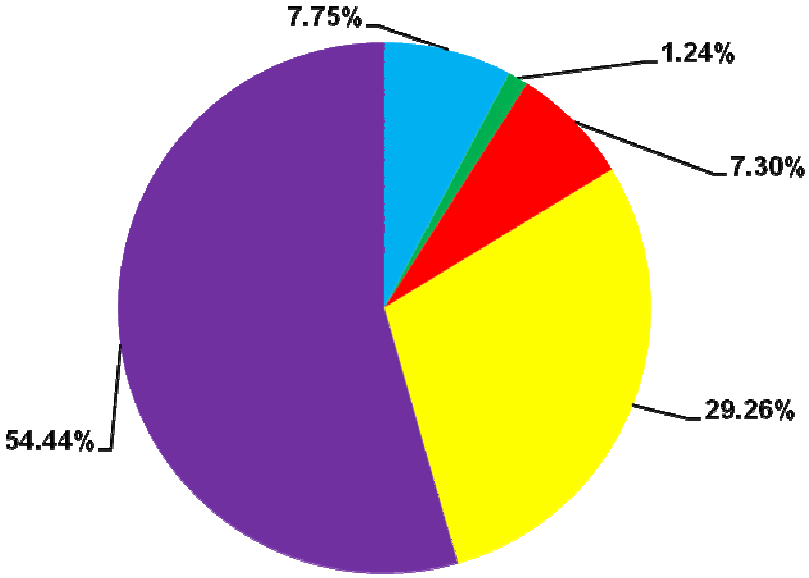


Industrial waste final destination (2002)

Non-Hazardous



Hazardous



- Landfill
- Incineration
- Incineration with energy recovery
- Recycling
- Other final destination

Industrial Waste

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incineration plants

Main characteristics of plants with IW incineration

Secil - Outão (Companhia Geral de Cal e Cimento, S.A.)

- ✓ **Activity:** cement production
- ✓ **License** for energy recovery:
  - non-hazardous industrial waste since 26th June 2005
  - hazardous waste since 27th October 2006
- ✓ **Hazardous waste recovered:** oily sludge, oils and solvents
- ✓ **Amount of waste received (2006):** 65 kt
- ✓ **Amount of waste recovered (2006):** 61 kt

Cimpor - Souselas (Cimentos de Portugal)

- ✓ **Activity:** cement production
- ✓ **License** for co-incineration of hazardous industrial waste since February 2008
- ✓ **Amounts** not available

Main characteristics of plants with IW incineration

CMP – Maceira Liz (Cimentos Maceira e Pataias, S.A.)

- ✓ **Activity:** cement production
- ✓ **License** for co-incineration of used tires (code 16 01 03) since 2006
- ✓ **Amount of waste received (2006):** 12 kt
- ✓ **Amount of waste recovered (2006):** 12.5 kt

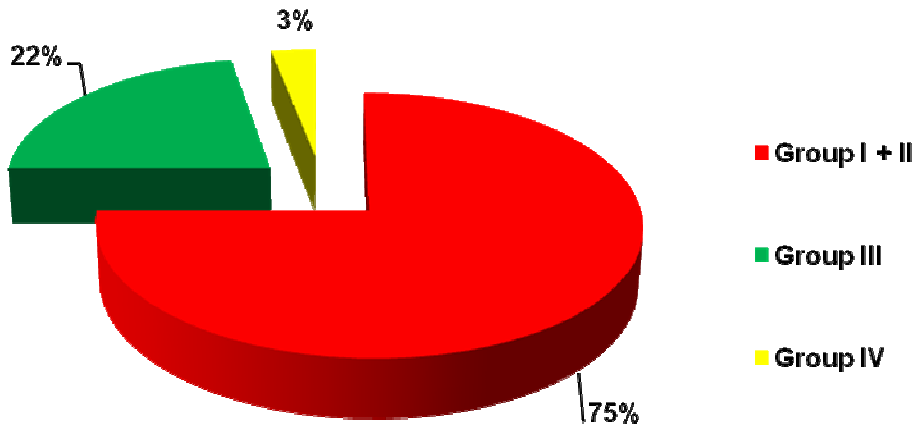
Recauchutagem Nortenha, S.A.

- ✓ **Activity:** electricity production
- ✓ **License** for used tires and others rubber wastes (codes - 07 02 99, 16 01 03, 19 12 04) since 2006
- ✓ **Amount of waste received (2006):** 11 000 kt
- ✓ **Exported energy (2006):** 7 GWh
- ✓ **Gas neutralization:** $NaCO_3$ (powder)

Health Care Waste

Health Care waste production (2005)

55 kt of Health Care Waste



Classification
(Despacho nº 242/96 from 5th July)

Group I
- wastes similar to MSW
- specific treatment not required

Group II
- non-hazardous waste
- specific treatment not required

Group III
- wastes with biologic risk
- incineration or pre-treatment + elimination as MSW

Group IV
- specific health care waste
- mandatory incineration

Hazardous Health Care waste treatment (2005)

Treatment method	Group III (in t)	Group IV (in t)
Incineration	1 000	1 400
Exported	--	n.a.
Chemical desinfection	1	--
Autoclaving	11 000	--

Health Care Waste

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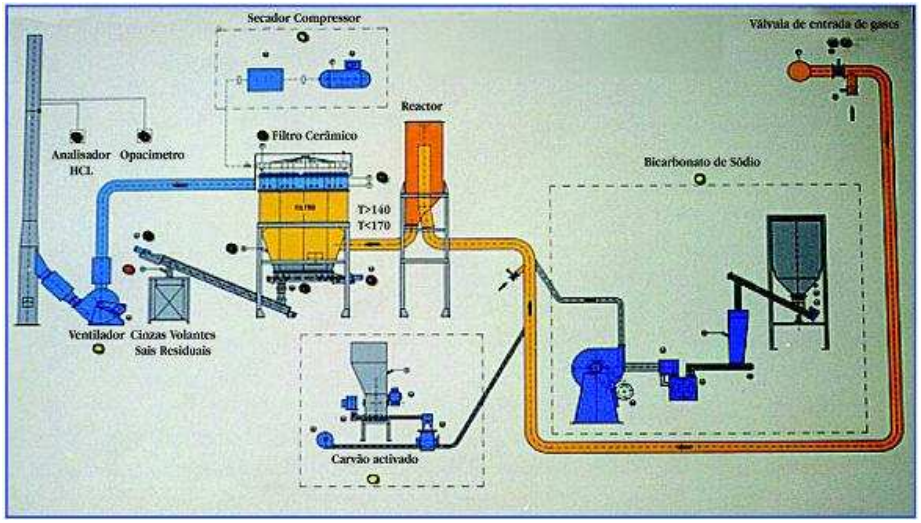
incineration plants

SUCH – Main characteristics of HCW incineration plant

- ✓ **2 stages**
  - Pyrolysis chamber 850-950ºC, 50kPa
  - Combustion of gases and particles

- ✓ **Gases treatment**
  - Dry method
  - NEUTREC from Solvay
  - Sodium bicarbonate + activated charcoal

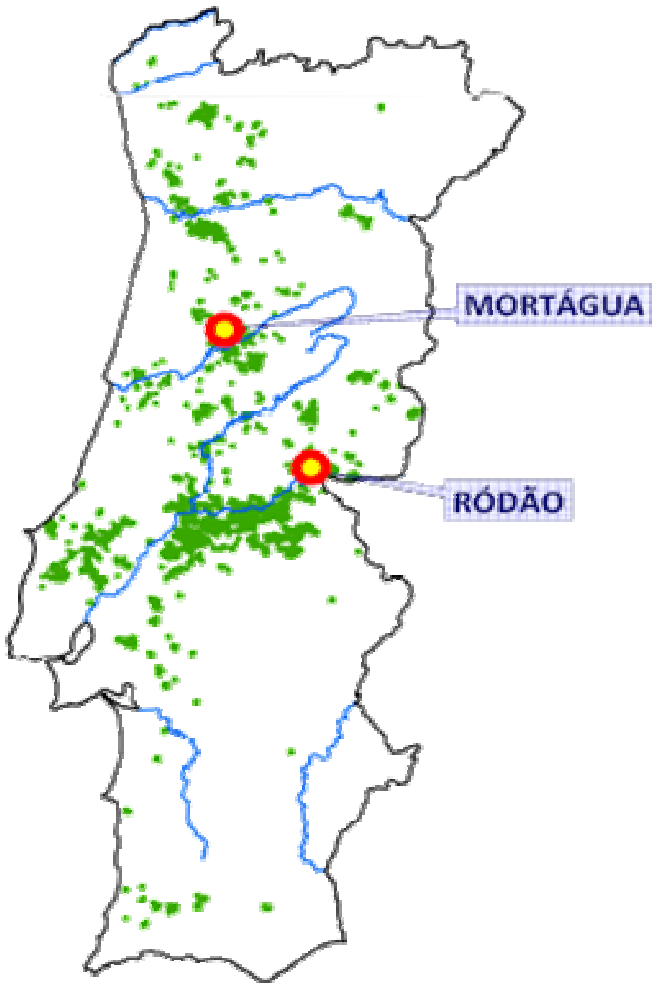


VALOR AMBIENTE - Main characteristics of HCW incineration plant

- ✓ Health care and Slaughterhouses wastes
- ✓ 2 lines
  - 0.5 t/h
  - combustion chamber 1100ºC
  - energy recovery
  - independent gas treatment systems
- ✓ 888 ton of waste treated in 2007

Biomass Waste

Biomass waste power plants



Biomass power plants connected to the electric grid:

- EDP, Mortágua
- Centroliva, Vila Velha de Ródão

Co-generation units in forest sector industries:

- Portucel Industrial, S.A.
- Amorim Revestimentos, S.A.
- Portucel Tejo, S.A.
- Stora Celbi, S.A.
- Soporcel
- Comp. de Celulose do Caima, S.A.
- Portucel Industrial, S.A. (Setúbal)
- Portucel Viana, S.A.
- SIAF

New biomass units

In February 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.

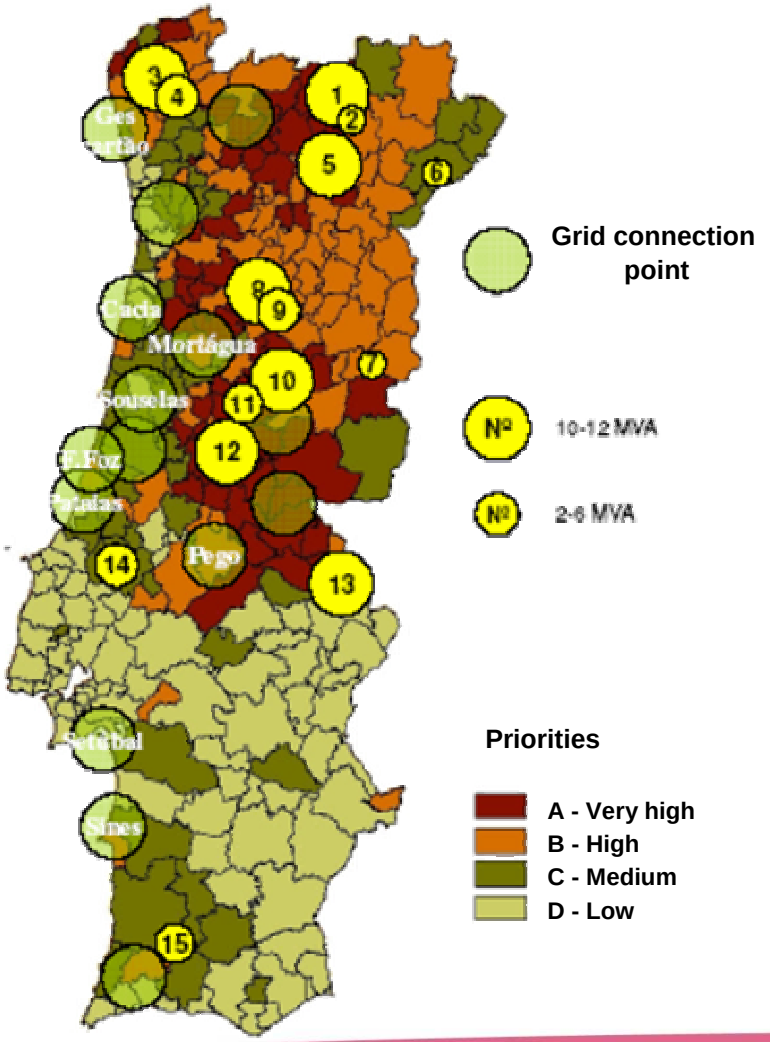
Two types of units were considered:

- **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.



Biomass Waste

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incineration plants

EDP, Mortágua

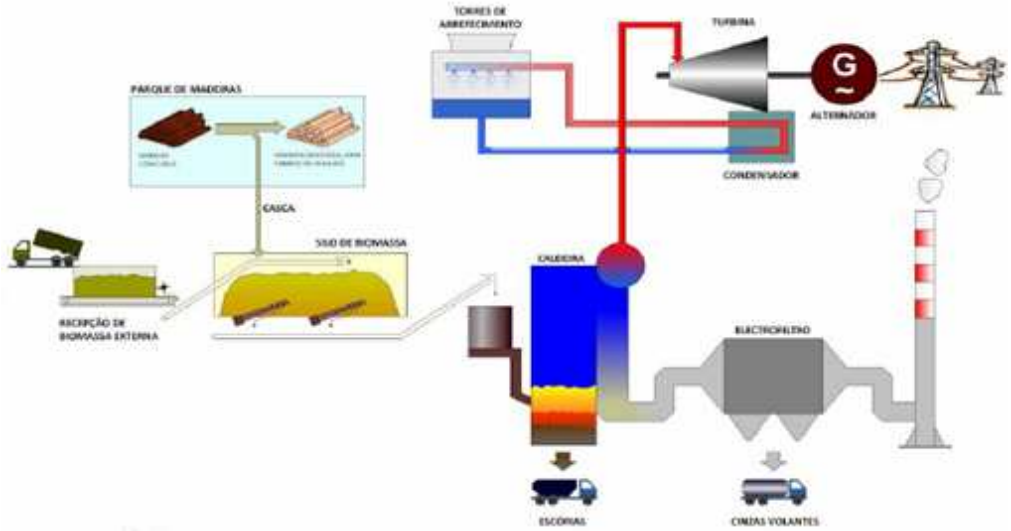
Main characteristics of biomass incineration plant

- ✓ In operation since: August, 1999
- ✓ Installed power: 9MW (10 MVA)
- ✓ Generation Potential: 60 kV
- ✓ Annual production at full load: 67 GWh
- ✓ Biomass consumption with 30% humidity
    - Hourly consumption at full load: 8.7 t/h
    - Biomass consumption: 109 kt/year
    - Lower heating value (LHV): 13 800 kJ/kg
    - Fuel park capacity: 55000 m^3

CENTROLIVA, Ródão

Main characteristics of biomass incineration plant

- ✓ In operation since: 2001
- ✓ Nominal power: 14.4 MVA
- ✓ Energy production: 80 GWh
- ✓ Combustion tecnology: Fluidized bed
- ✓ Biomass consumption: 160 kt/year



CONCLUSIONS

• Despite the controversy, the incineration of waste has an important role in the management of all types of waste in Portugal – urban, industrial, health care and biomass.

• The existing units have intensive use and meet the legal environmental requirements.

• The possibility of installation of new units is recognized and certainly will help the country to be self-sufficient in waste management and in some situations to improve the energy performance.

ACKNOWLEDGEMENTS

The Authors wish to thank Ms. Dora Lopes and Eng. Raquel Oliveira for her valuable help in the data compilation and industries contacts.

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