

# Indaver Doel waste-to-energy site



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- Date: 02-07-2010
- Location: Doel

*Indaver, leading the field in  
sustainable waste management*



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  - **Grate incinerator & ash treatment**

# Indaver's mission statement

*“Indaver, leading the field in sustainable waste management”*

**5 core values**  
pointing us in the right direction in our actions.

# Our core values

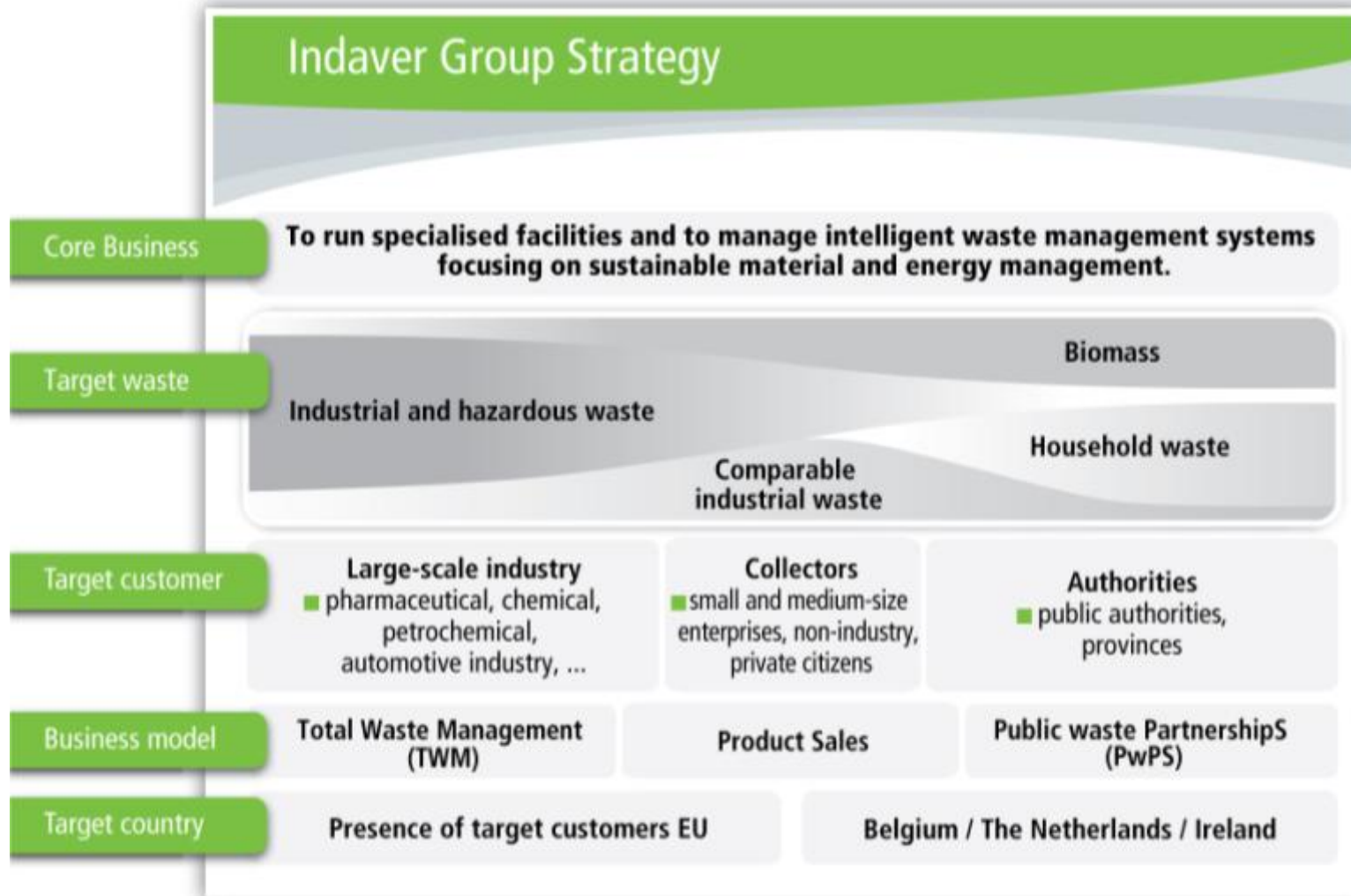
- Demonstrating concern for people, safety and the environment
- Building relationships based on mutual trust
- Ensuring transparency in communications and actions
- Concentrating on achieving results
- Continuously improving



# Indaver at a glance

- Leading European Waste Management Group (2009 figures)
  - Management of 3 million tonnes of waste per year
  - In house processing: 2.2 million tonnes
  - Over 1400 employees
  - Turnover 365 Mio Euro
- Mixed shareholding
  - DELTA: 75 %
  - VMH: 16 %
  - Other Industry: 9 %

# Business Strategy

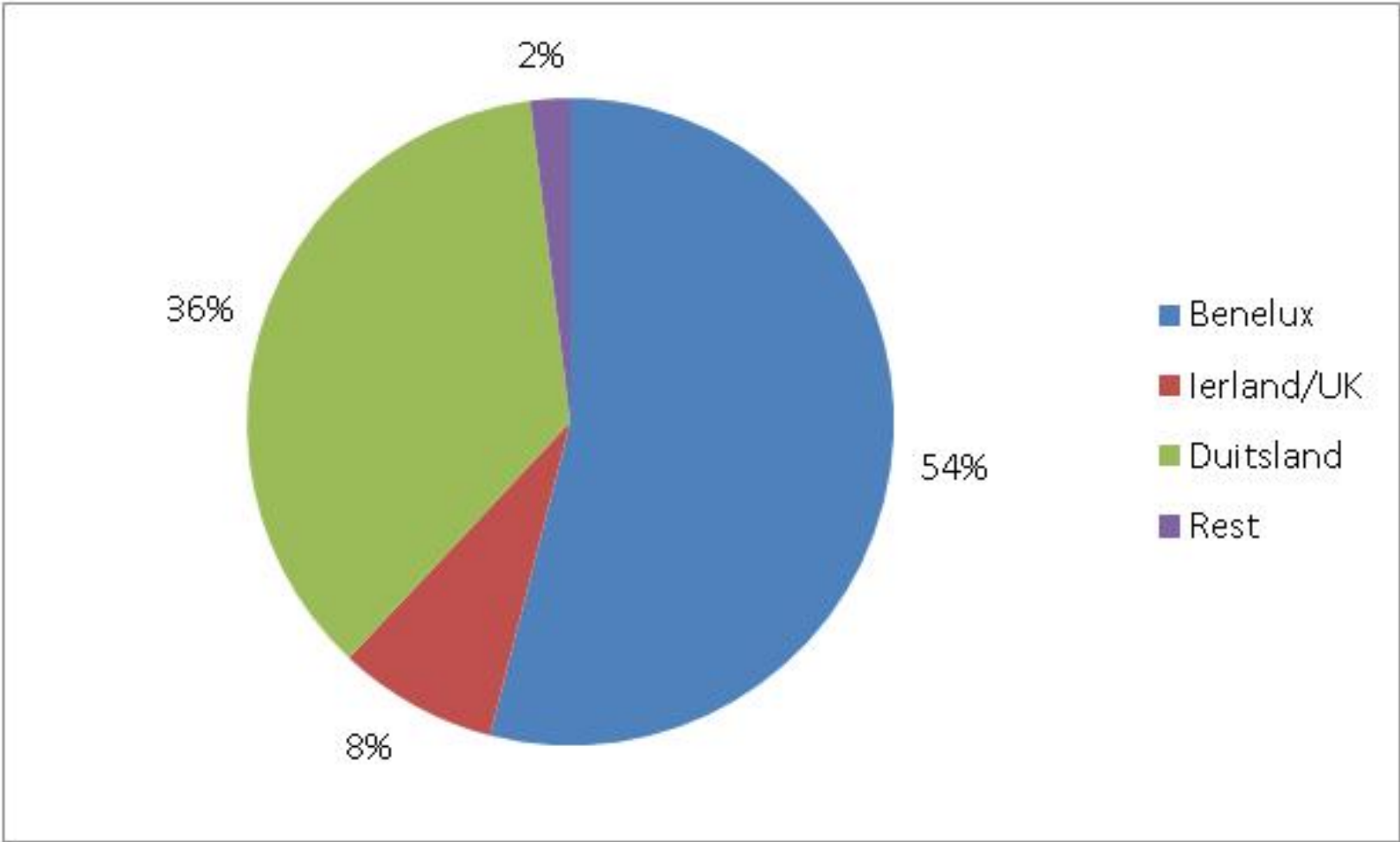




# Indaver in Europe



# INDAVER turnover in Europe 2009





# Indaver's waste treatment facilities

## ■ recycling and materials recovery

- recovery of paper and cardboard, plastics, household packaging waste, solvents, fluorescent tubes, mercury vapour lamps and other mercurial waste
- sorting / shredding of wood, rubber tyres
- aerobic composting and anaerobic digestion of bio-organic waste and production of biomass
- pretreatment of high calorific value waste => converted into energy sources for co-incineration

## ■ thermal treatment with energy recovery

- rotary kilns => hazardous waste
- grate incinerators => non-recyclable, non-hazardous waste
- fluidized bed incinerators => non-recyclable solid waste, sludge from water purification units, industrial sludge

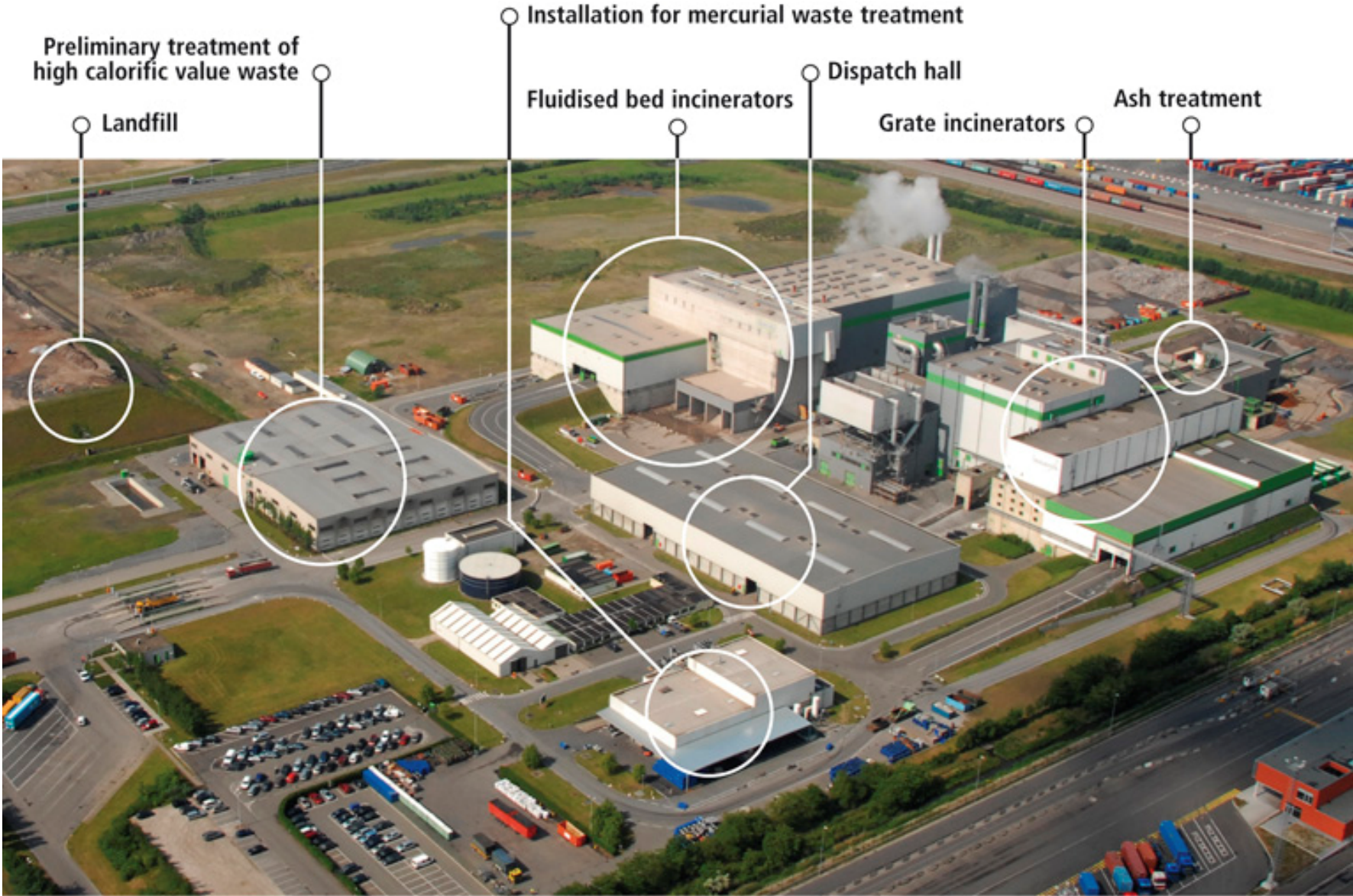
## ■ final disposal

- physico-chemical treatment
- category 1 and 2 landfills (site Doel and Antwerp)
- category 2 landfill with valorisation of the thermal energy (Hooge Maey)

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# Indaver Doel



# Indaver site Doel capacities W2E

- Grate incinerator
  - 393 422 tonnes/year
  - Thermal treatment of non-hazardous, non-recyclable household and similar commercial waste
  - Energy recovery: electricity and steam
  - Materials recovery (ash treatment)  
=> secondary raw materials
  
- Fluidized bed incinerator (SLECO)
  - Non-recyclable solid waste, sludge from water purification units, industrial sludge
  - 447 407 tonnes/year





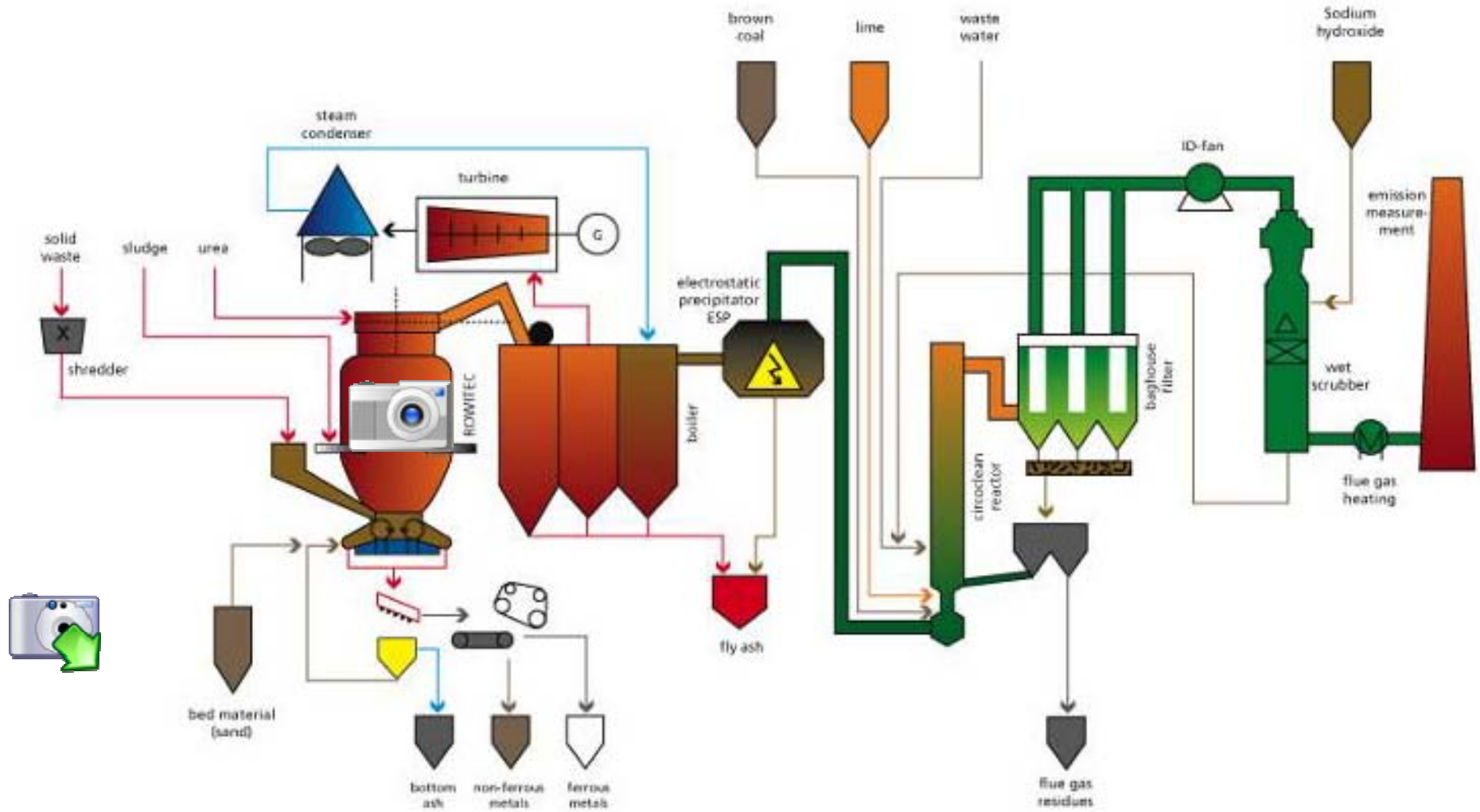
# Fluidized bed incinerator

- Part of a future-oriented waste and climate policy in Flanders
- Fluidized bed technology = Best Available Technique for combined treatment of non-recoverable waste and sludge
- Maximum energy recovery and intensive flue gas purification
- Largest facility of this type in Europe
- Indaver and Sita Belgium: joint-venture 50/50 in Sleco and Svex

- SLECO: **owner** of the fluidized bed incinerator
- SVEX: responsible for **operating** all waste-to-energy facilities on site



# Fluidized bed incinerator: treatment diagram





# Fluidized bed incinerator: mass balance

## Massabalans

### IN

Afvalstoffen 454472 ton

#### Energie

Stookolie 858 ton

Stoom 160658 GJ

Elektriciteit 34314 MWh

#### Hulpstoffen rookgasreiniging

Ongebluste kalk 8075 ton

NaOH 504 ton

Adsorbent voor dioxines en zware metalen 389 ton

DeNOx reagens 1387 ton

#### Hulpstoffen oven

Zand 5798 ton

#### Water

Leidingwater 227802 m<sup>3</sup>

Regenwater hergebruik 5600 m<sup>3</sup>



### UIT

#### Emissie lucht

Rookgassen 2317719 x 10<sup>3</sup> Nm<sup>3</sup>

#### Energie

Energie 3296605 GJ

#### Emissie water

Afvalwater 0 m<sup>3</sup>

#### Restproducten

Bodemassen 25117 ton

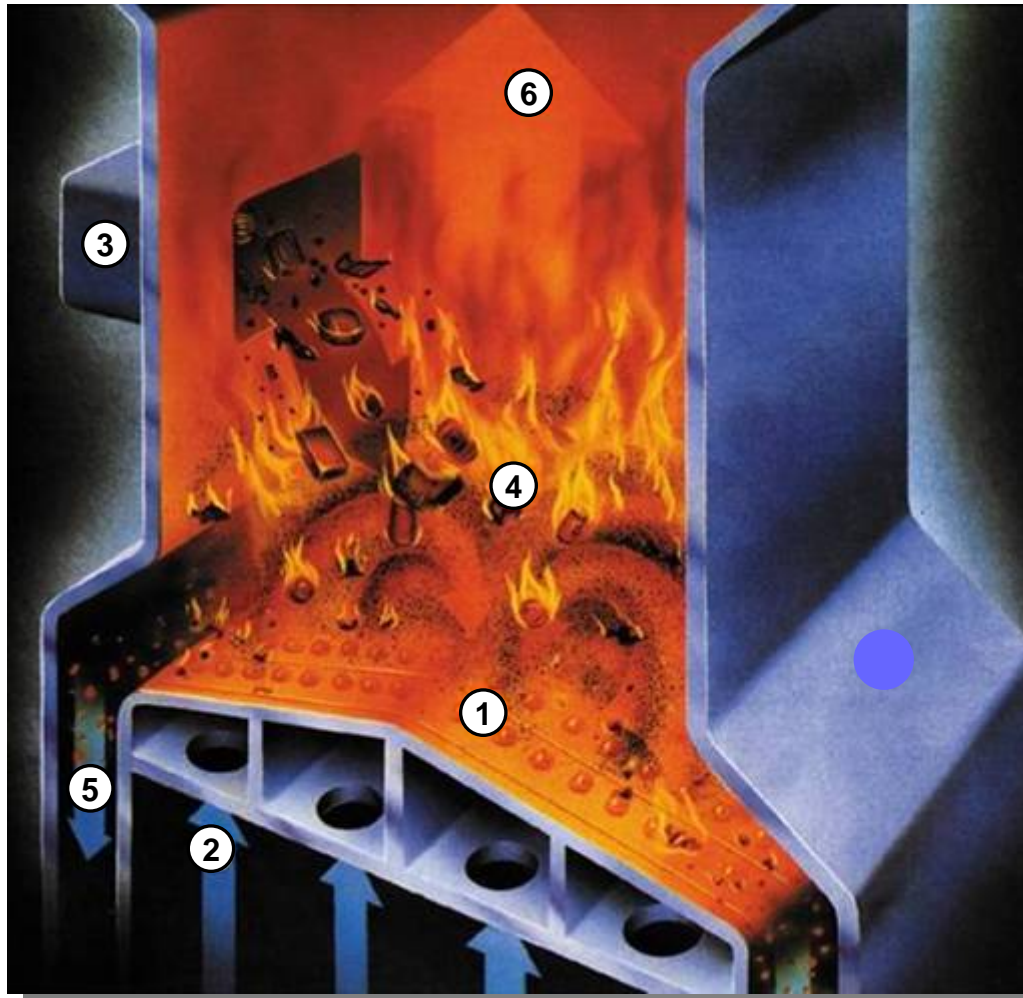
Elektrofilter- en ketelassen 56672 ton

Rookgasreinigingsresidu 12454 ton

Schroot ovenkwaliteit 1582 ton

Schroot uit voorbehandeling 12546 ton

# Fluidized bed incinerator: treatment process



1. Incineration takes place on a bed of swirling sand
2. Hot primary air is blown through the sand bed from below
3. Waste is fed into the oven on top of the sand bed
4. Secondary air is added over the top for complete combustion
5. Screws withdraw the sand and bottom ash from the incinerator. Sand is screened and reused.
6. Flue gases set out on their way through the flue gas purification system

# Fluidized bed incinerator: energy recovery

- Steam output is fed to the turbine-driven generator and converted to electricity
- Turbine rating: 34 MW
- Electricity generated is equivalent to electricity consumption of 70 000 families (with a mean annual consumption of 3,500 kWh)
- $R1 > 0.8$  (CEWEP draft guide line)

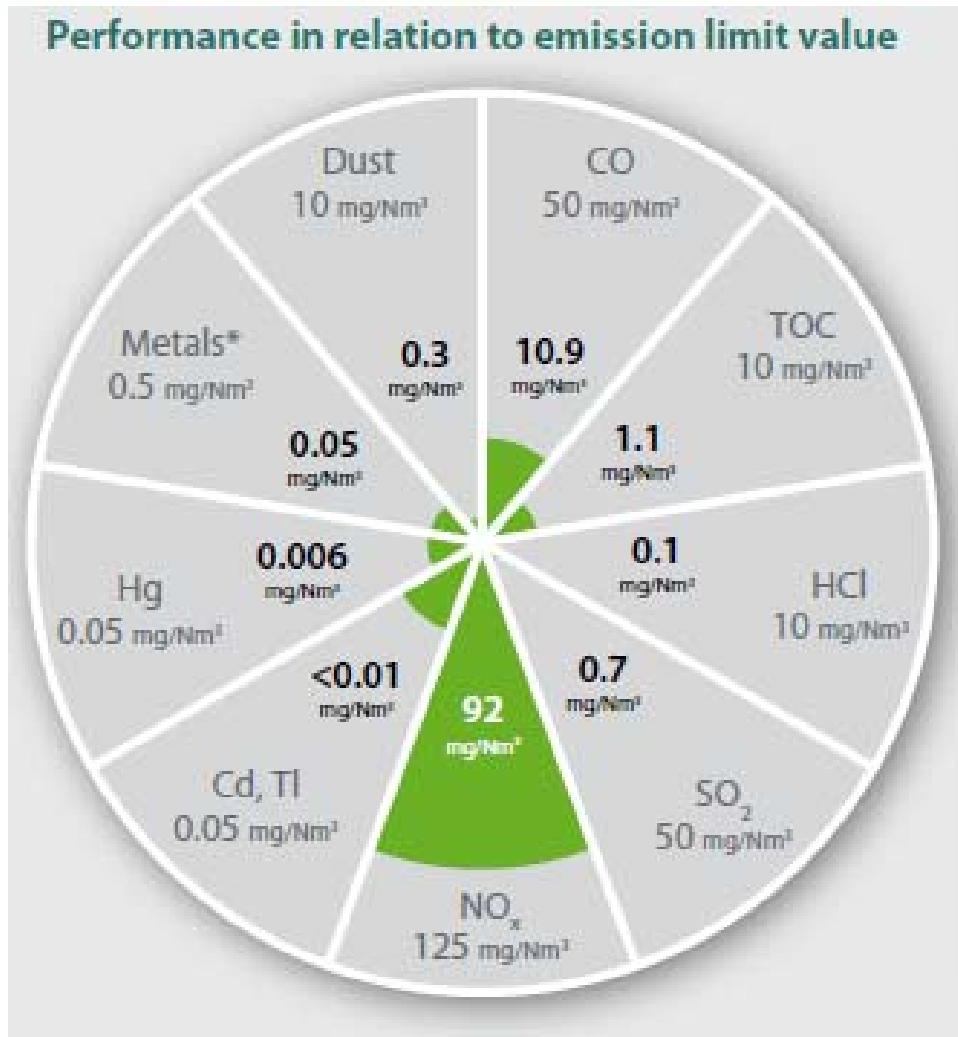


# Fluidized bed incinerators: energy recovery

Energy recovery in the boiler	3,296,605 GJ
Process steam, on-site use	160,658 GJ
Process steam, external use	N/A
Electricity generation fluidised bed incinerator steam *	265,901 MWh
Electricity generation grate incinerator steam *	24,541 MWh
Electricity, on-site use	34,314 MWh
Electricity, external use	231,587 MWh

\* Part of the grate incinerators' steam purchased by Electrabel is bought back by SLECO and converted into electricity in the fluidized bed incinerator turbine. Total electricity generation fluidized bed incinerator = 290,442 MWh.

# Fluidized bed incinerators: performance



■ Daily average standard unless otherwise stipulated in environmental licence

■ Performance 2009

Emission limits in mg/Nm<sup>3</sup>

- dry flue gas
- **actual** oxygen

(+/- 15 % lower than EU-limits)

\* Metals: sum of Sb, As, Pb, Cr, Co, Cu, Mn, Ni, V, Sn

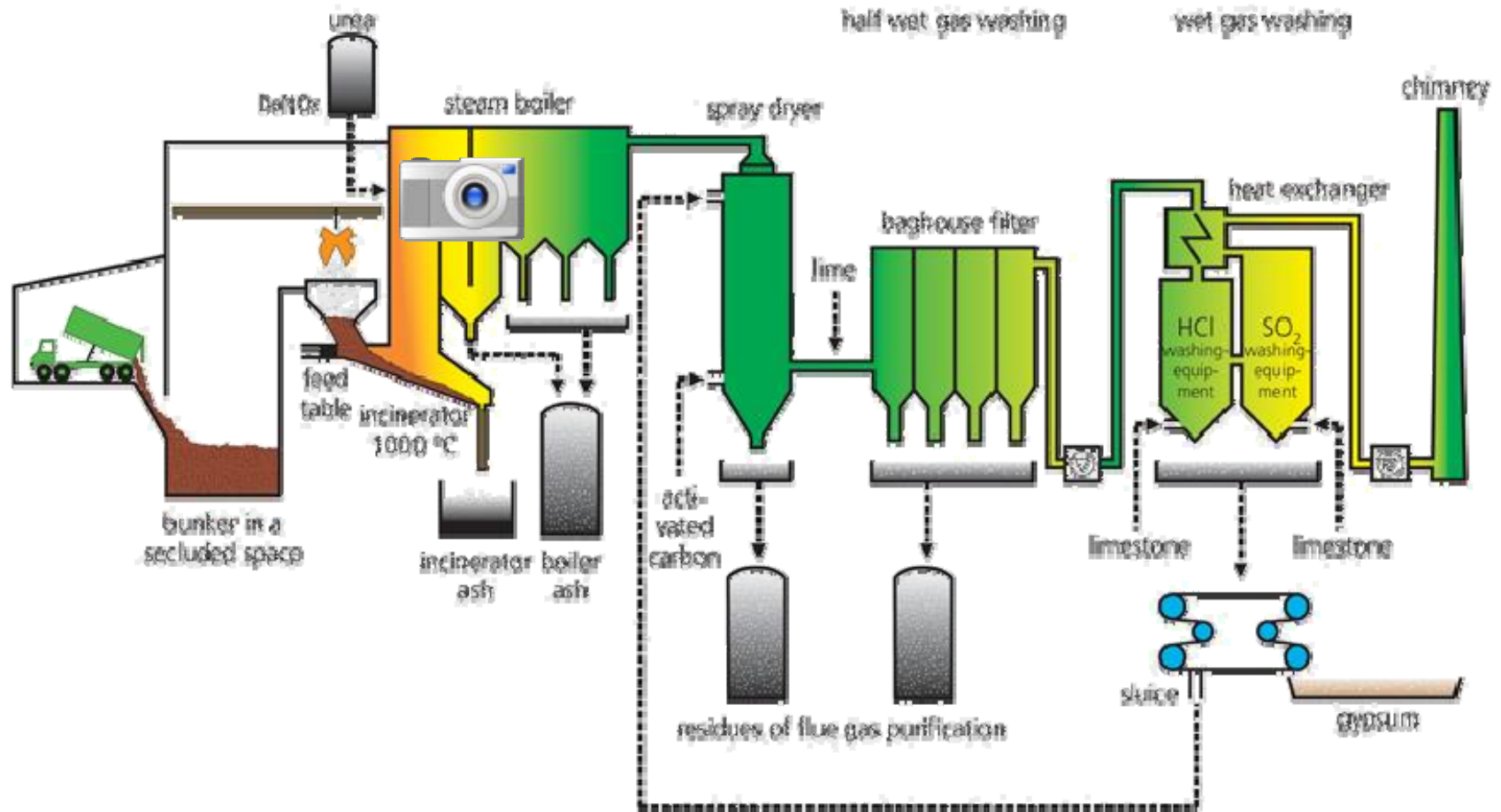


# Grate incinerator





# Grate incinerator: treatment diagram



# Grate incinerator: mass balance + Ash treatment: materials recovery

## Mass balance

### IN

Waste	391,904 tonnes
<b>Energy</b>	
Fuel oil	576 tonnes
Steam	183,568 GJ
Electricity	29,804 MWh
<b>Additives</b>	
Unslaked lime	1,744 tonnes
Limestone	3,193 tonnes
Adsorbent for dioxins and heavy metals	193 tonnes
DeNOx reagent	846 tonnes
<b>Water</b>	
Mains water	182,263 m <sup>3</sup>
Rainwater	33,854 m <sup>3</sup>



### OUT

#### Emissions to atmosphere

Flue gases 2,033,580 x 10<sup>3</sup> Nm<sup>3</sup>

#### Energy

Energy 3,344,152 GJ

#### Water discharged

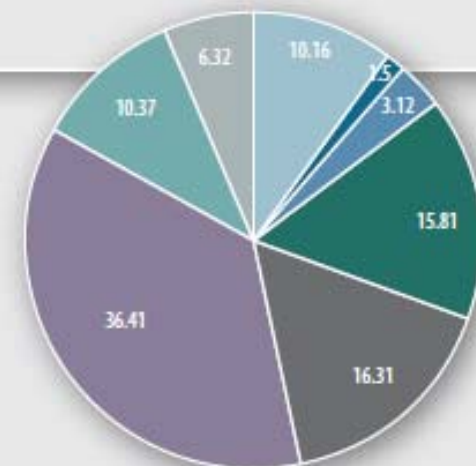
Wastewater 0 m<sup>3</sup>

#### Residual products

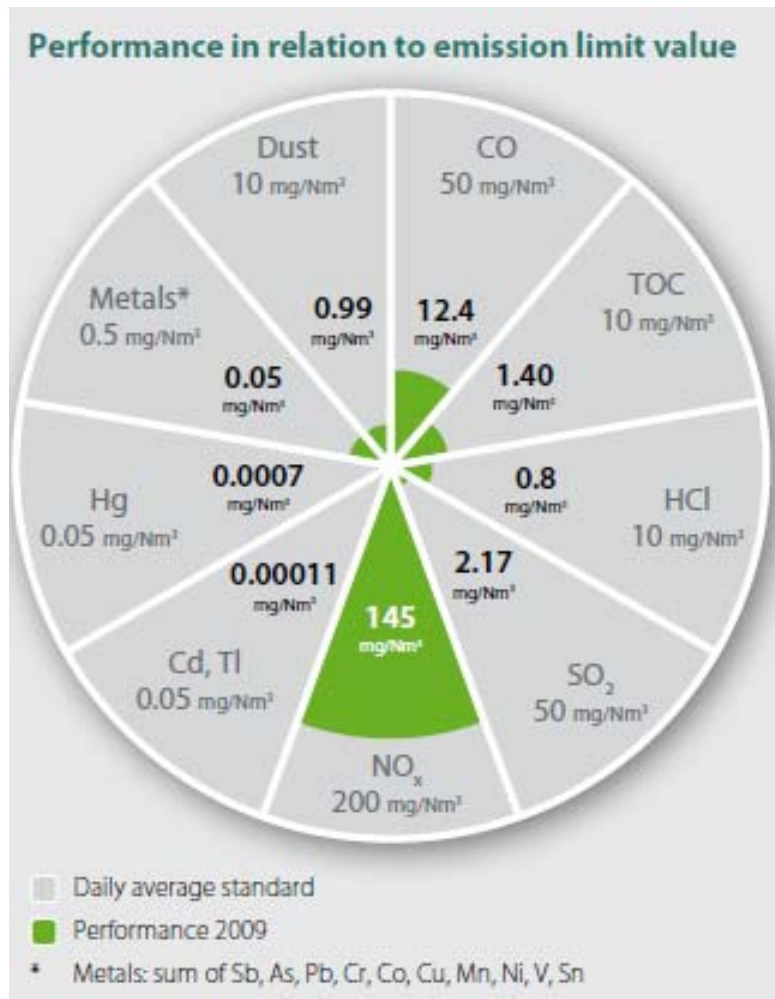
Bottom ash \* 88,771 tonnes  
 Boiler ash 8,396 tonnes  
 Flue gas cleaning residue 10,889 tonnes  
 Plaster 967 tonnes

#### \* Composition of the bottom ash (%):

Ferrous fraction	10.16
Non-ferrous fraction	1.5
Weak magnetic fraction	3.12
Granulate 6-50 mm	15.81
Granulate 2-6 mm	16.31
Sand fraction 0.67-2 mm	36.41
Filter cake / sludge fraction <0.67 mm	10.37
Residual fraction	6.32



# Grate incinerator: performance



Emission limits in mg/Nm<sup>3</sup>  
 - dry flue gas  
 - **actual** oxygen

(+/- 15 % lower than EU-limits)

# Grate incinerator: energy recovery

## ■ Energy recovery

### Grate incinerators Doel

2009

Energy recovery in the boiler	3,344,152 GJ
Process steam, on-site use	183,568 GJ
Process steam to fluidised bed incinerator	292,264 GJ
Process steam, external use	808,880 GJ
Electricity generation total	167,955 MWh
Electricity, on-site use	29,804 MWh
Electricity, external use	138,151 MWh

# Ash treatment



- treatment of bottom ash (residues of thermal treatment)
- Application of bottom ashes:
  - road construction
  - construction of dykes
  - covering layers on landfill

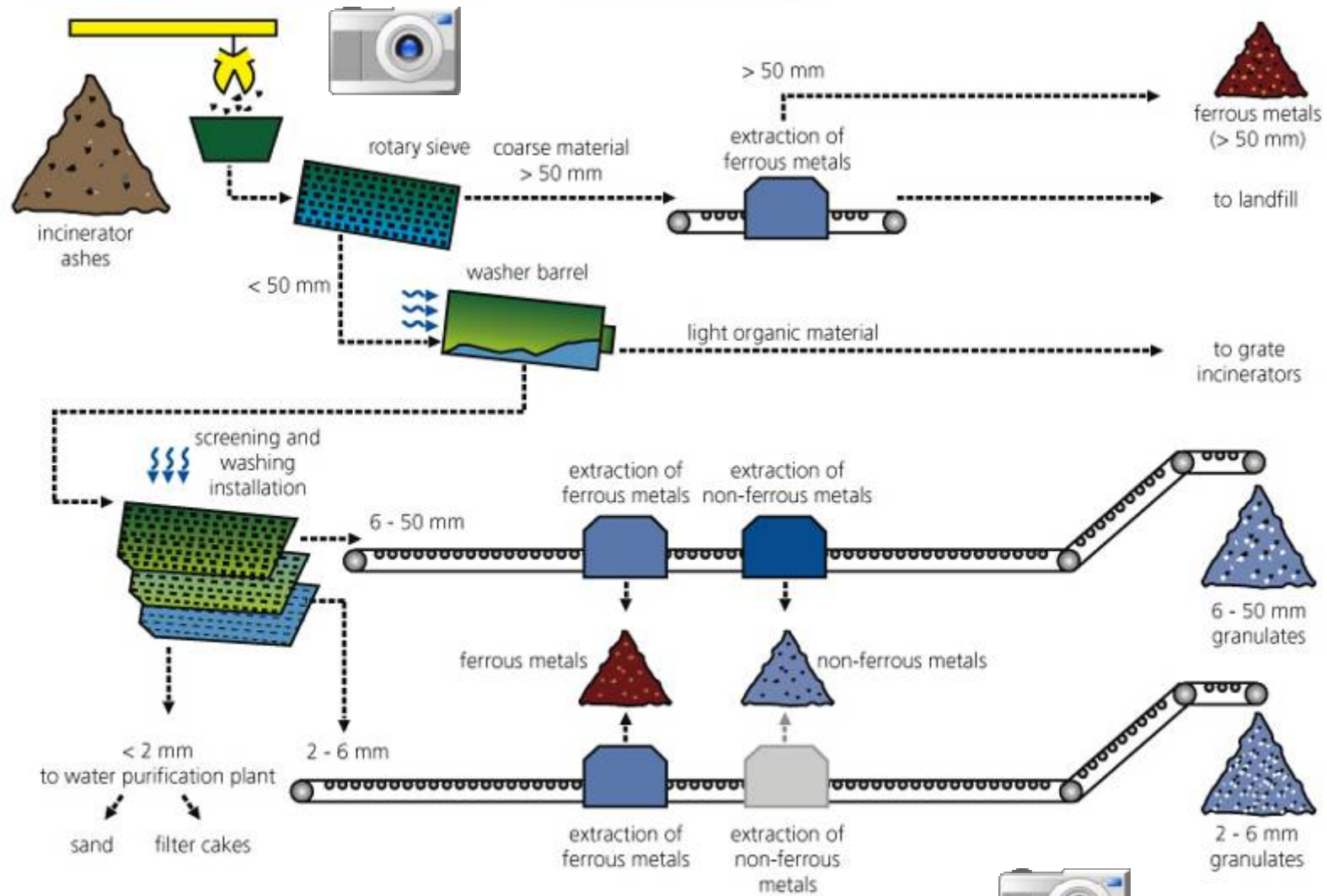


# Bottom ash recycling plant

- Start up installation: 2000
- Capacity: 165000 T/y
- Technology: wet process
  - sieving :
    - metals & stones are removed using a robust bar-sieve
    - separation on granular size
  - separating of F / NF metals
  - washing
    - separation by flotation



# Ash treatment: treatment diagram





raw bottom ash



Fraction 0-2 mm



Fraction 2-6 mm



Fraction 6-50 mm

# Application of different fractions

- **Scrap** (fraction > 350 mm) => recycling
- **F / NF metals** => recycling
- **granulates**
  - reuse in granular or monolithical applications
  - reuse is possible as described in VLAREA
  - need of a certificate of reuse (OVAM)

## Overview of different fractions

Fraction	Application	% (w/w) of bottom ash
F – metal	Recycling	8.5
NF- metal	Recycling	1.0
Granulate 2 – 6 mm	Granular or monolithic applications in constructions	14
Granulate 6 – 50 mm		27
<b>Total of 'free use' application</b>		<b>50.5</b>
Sand 0.1 – 2mm	Controlled application in construction on landfill (covering)	32
<b>Total of application with further monitoring</b>		<b>32</b>
Sludge < 0.1 mm	Landfill	8
Organic	Returned to grate furnace	1
Others	landfill	8.5
<b>Total to be disposed of</b>		<b>17.5</b>

# Indaver Doel's W2E facilities: climate-neutral

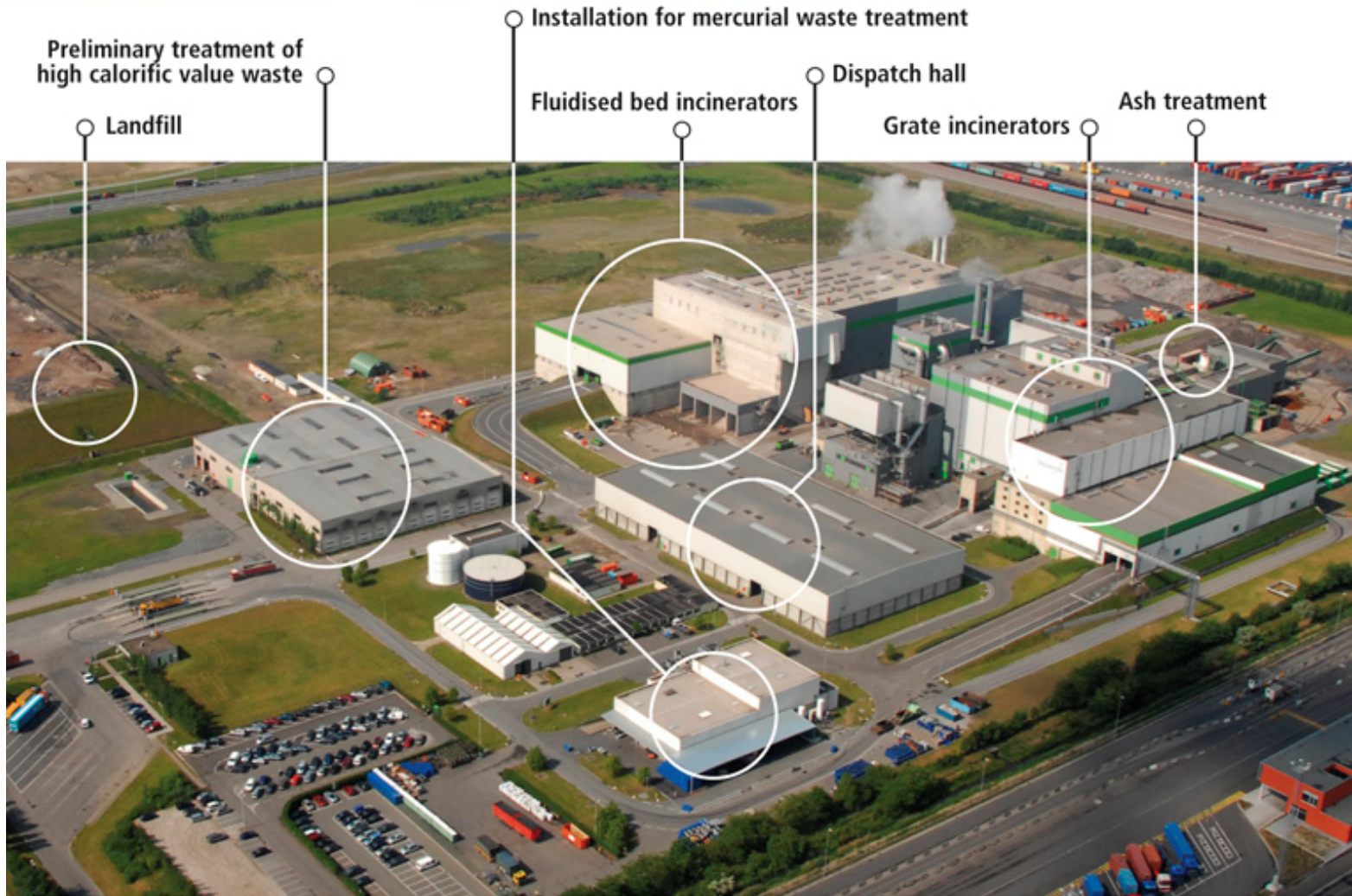
- 49% of the waste treated in the fluidized bed facility is organic-biologic and considered a source of renewable energy. The electricity from this waste is rewarded with 'green power certificates'.
- The treatment proces aims for maximum recovery of metals from the incoming waste and from the bottom ashes for recycling.

	tonnes of waste treated	CO2 emission		CO2 avoided				difference CO2 emission-CO2 renewable-CO2 avoided
		(in tonnes)		(in tonnes)				
		total	renewable	electricity	heat	metals	total	
grate incinerators	391 904	424 502	-223 110	-90 696	-102 652	-20 771	-214 118	-12 726
fluidized bed incinerators	454 472	480 025	-258 733	-156 839	0	-24 087	-180 926	40 366
<b>total</b>	846 376	904 527	<b>-481 843</b>	-247 534	-102 652	-44 858	<b>-395 044</b>	<b>27 640</b>

→ Balance = CO2 neutral



# Site visit







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Ash treatment : organic material





Ash treatment : granulate fraction 6 – 50 mm





Ash treatment : granulate fraction 2 – 6 mm





**Ash treatment : sand fraction**





Ash treatment : ferro fraction





































4 augustus 2004





23 augustus 2004





17 september 2004





28 oktober 2004





17 december 2004







27 januari 2005





27 januari 2005



28 februar 2005







2 april 2005



13 juni 2005







8 september 2005



6 maart 2006

