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# Role of Thermal Treatment Facilities in Sustainable Waste Management

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# Content:

- Waste arisings in Germany
- Waste management in Germany, Legislation
- Sustainability in Waste management
- Closed substance cycle economy
- Waste sector‘s contribution to climate protection
- Thermal Waste treatment plants
- Environmental performance of WTE-plants
- Conclusions

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# Waste arisings in Germany

82 million inhabitants in Germany

- Total waste amount: 331 million tons (2005)
- Construction and demolition waste: 185 mill. tons
- Mining residues: 52 mill. tons
- Production and Industrial Waste: 48 mill. tons
- Municipal solid waste: 46 mill. tons
- Domestic waste: 41 mill. tons (part of MSW)
- Hazardous Waste: 18 mill. tons

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# Waste management in Germany: Legislation

- Waste Management Act 1986
  - waste hierachy
  - reduction of waste volume
  - reduction of harmful substances
- Technical Instructions on Waste from Human Settlements 1993
  - to recover as much as possible
  - to reduce harmful substances
  - to ensure an environmental treatment and landfill
  - Target for landfill ban in 2005

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# Waste management in Germany: Legislation (2)

Further Regulations

- Seventeenth Federal Immission Control Ordinance 1990

  (Ordinance on waste incineration plants)

  - emission limits for dioxins, furans, heavy metals

- Closed Substance Cycle and Waste Management Act 1996

  - dual waste management concept

  - from waste management to resource management

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# Waste management in Germany: Legislation (3)

- Waste Storage Ordinance 2001
  - landfill ban for untreated waste after 1 June 2005
  - legal obligation placed on the waste owner and landfill owner
  - no exemptions after 1 June 2005
  - Residues of mechanical biological treatment and waste incineration may be still landfilled

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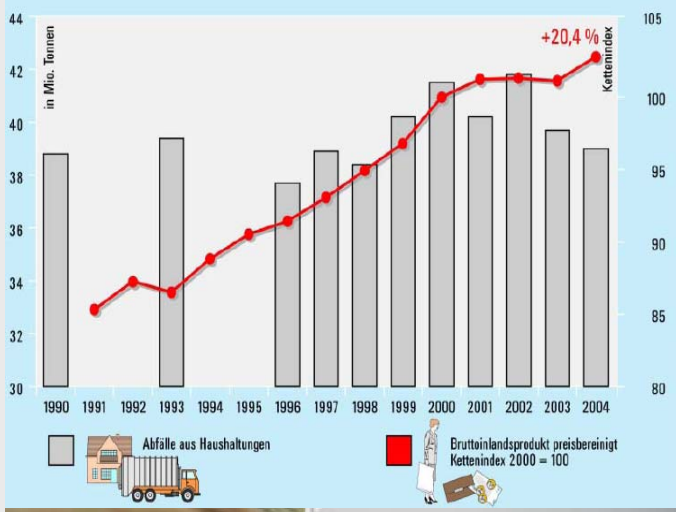
# Sustainability in waste management




➢ Reduce
- efficient use of materials and energy
- internal recovery in production

➢ Reuse
- returnable systems

➢ Recovery
- recycling
- energy recovery


Machine for returning deposit bottles

# Closed substance cycle economy

- cooperation with stakeholder
- legal framework
- clear responsibilities: domestic waste > local authorities
  other waste > industry
- Extended Producer Responsibility
- voluntary agreements
  waste paper - 1994 -
  construction and demolition waste - 1996 -
- return and recycling/recovery obligations
  packagings - 1992 -
  end-of-life vehicles - 1998 -
  waste batteries - 1998 -
  electrical and electronic scrap - 2006 –

- internalization of costs
- landfill ban for untreated waste

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# Separate collection

- waste paper
- glass
- packaging waste
- waste batteries
- electronic waste
- biowaste
- waste oil



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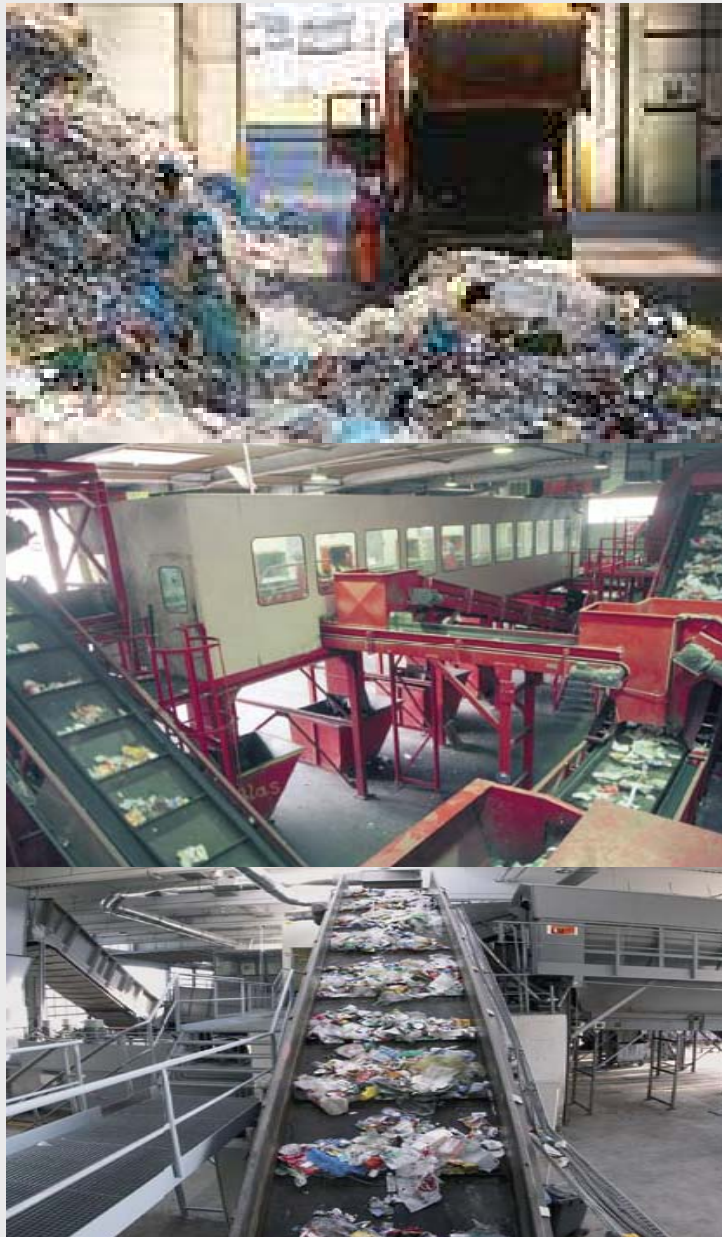
# Sorting and treatment

- modern technologies
- high quality of secondary raw material
- market for recycling products



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# Recovery-Quotas

- household waste – 59%
- production waste – 42%
- construction waste – 86%
- packagings – 81%
- waste paper – 82%
- glass – 88%

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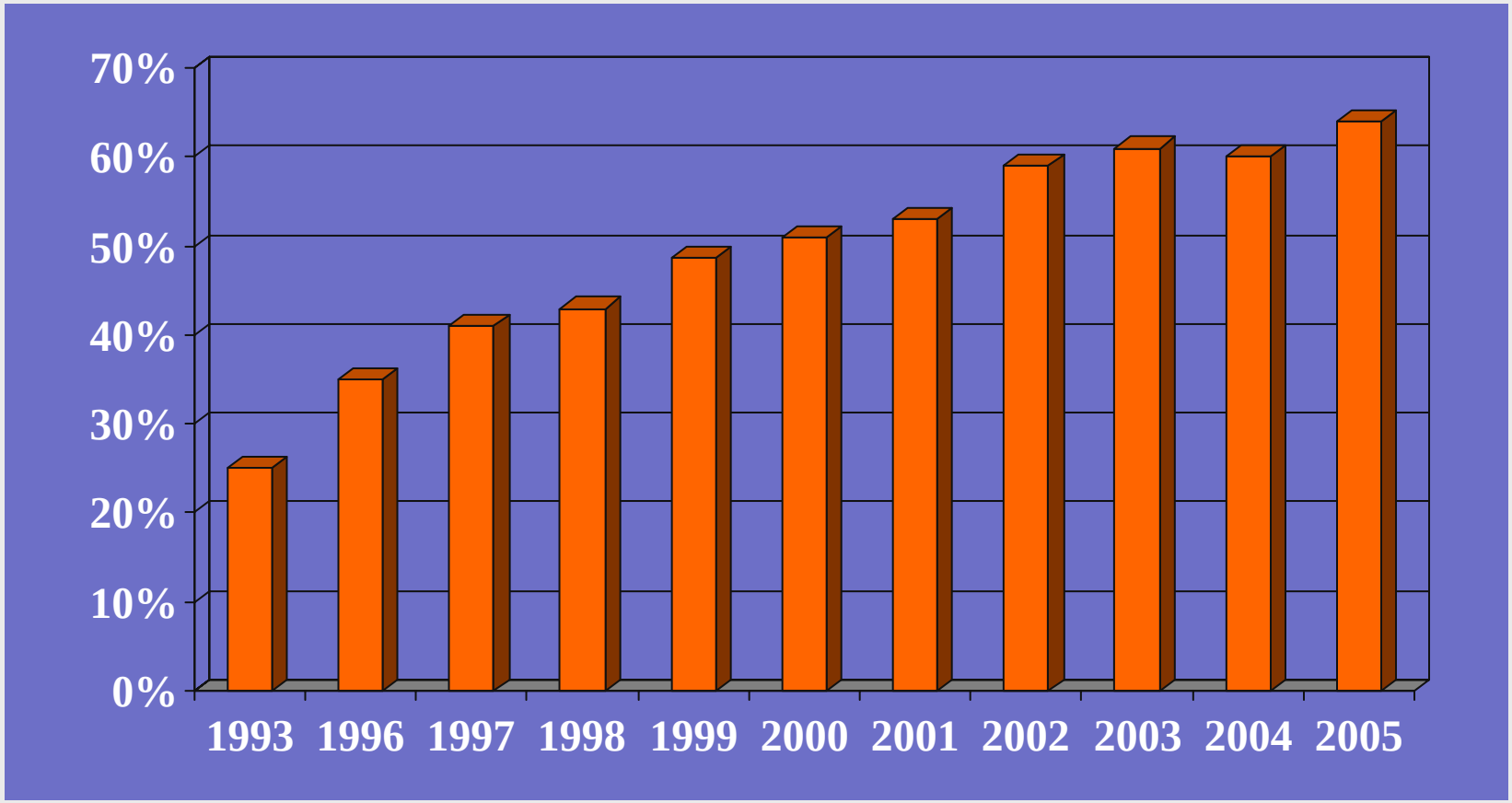
# Recycling of Household Waste



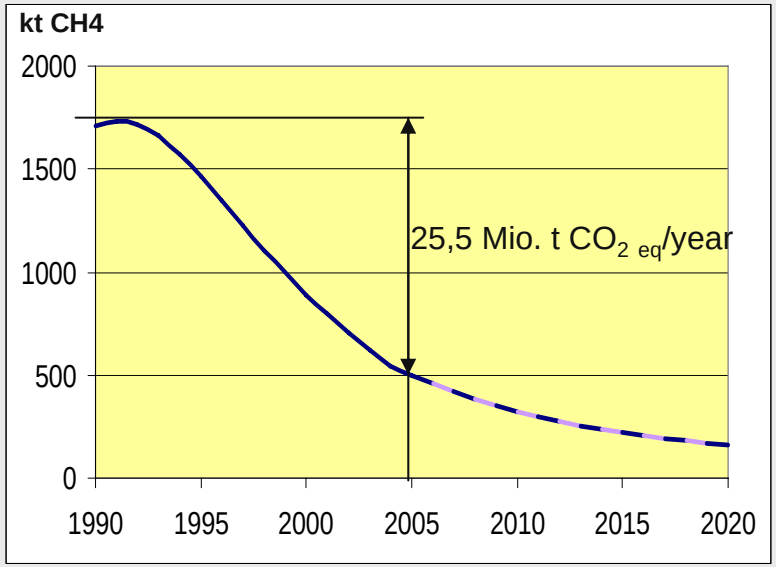

Recycling is important but not sufficient!

# Waste sector‘s contribution to climate protection

**1990-2005: Savings of 46 Mio. t $CO_{2\ eq}$/year**

Main measures:

- $CH_4$ – reduction from landfills: collecting and burning in cogeneration units
- Landfill ban 2005
- Enlargement of incineration capacity
- Increased energy efficiency of WtE-Plants
- Extended material recycling since 1990 by the factor 4




**$CH_4$-emissions from landfills**

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# Outlook to Europe: Potential of the Waste Sector to contribute to Climate Protection

- Ban of landfilling unpretreated waste in EU -15 can avoid 134 million tons $CO_2$ equivalents. This is equivalent to 11 % of the post Kyoto maximum target of a 30 % emission reduction in 2020.
- A consequent implementation of the EU-Landfill Directive could reduce the emissions by 74 million tons $CO_2$ equivalents

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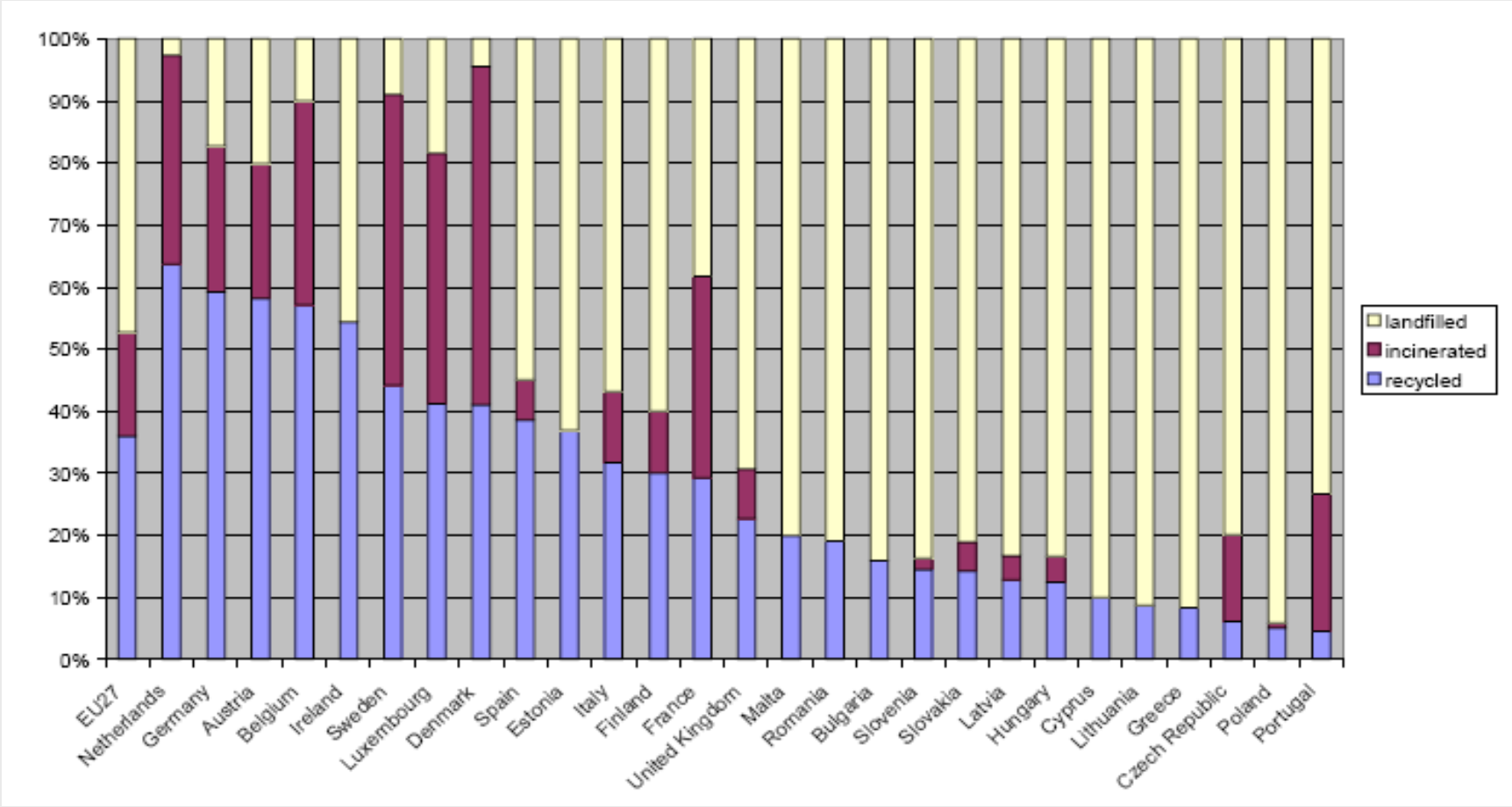
# Management of municipal waste in the EU 27 (2004)



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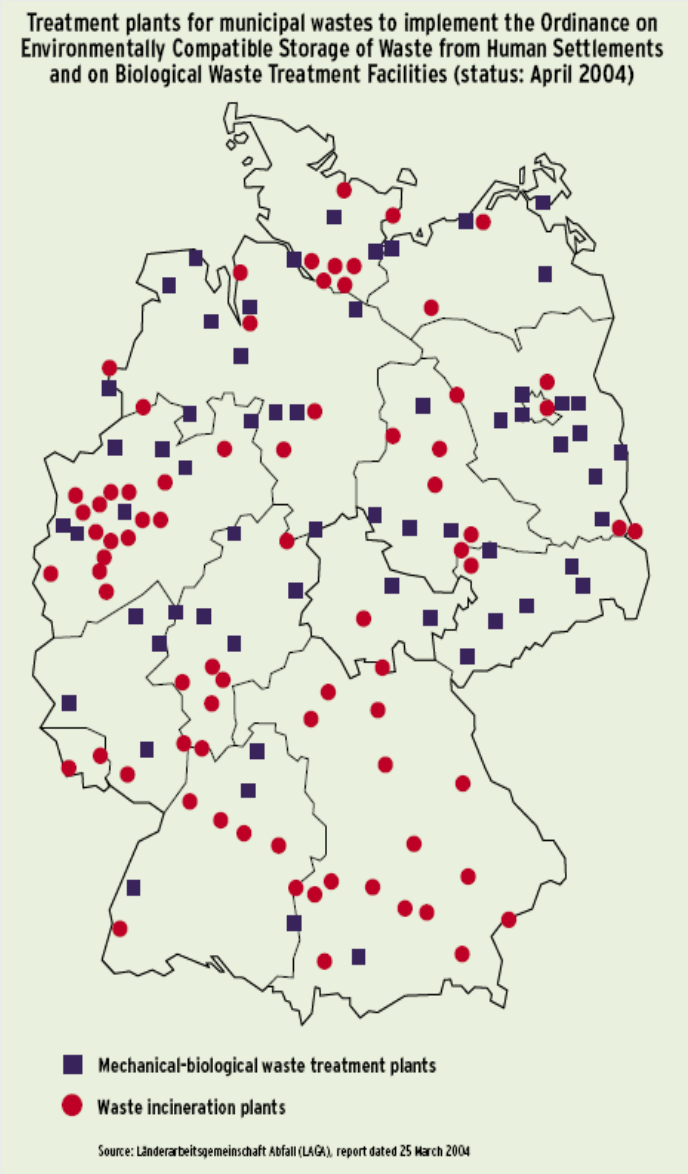
# Thermal Waste Treatment in Germany

- 68 WtE – 17,5 Mio. t/year cap.
- 70 MBWTP – 7 Mio. t/year cap.
  → 3 Mio. tons RDF for Co-incineration (powerplants, cement kilns) and RDF-incineration plants
- 30 Hazardous waste incineration plants (1,2 Mio. t/year)
- Sewage sludge: 23 incineration plants and co-incineration (1,2 Mio. t/year)
- Clinical waste: 1 incineration plant and co-incineration in WtE-plants
- 160 Biomass/Waste-wood incin. plants



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# Waste Incineration in Germany

Long Tradition: from 1895

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# Waste Incineration in Germany

… up to now

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# Waste to Energy plants in Germany

- 68 Municipal solid waste incineration plants with a capacity of 17,5 million tons/year

  → all plants with energy use (WtE)
- Throughput range: from 34.000 tons/year to 670.000 tons/year,
  → average: 230 000 tons/year
- 2 lines to 4 lines, ranges from 5 tons/h to 35 tons/h
- All plants have grate firing systems (broad-band technique)
- Thermal treatment cost/charges 90 Euro to 250 Euro per ton waste (average 170 Euro/ton)
- All plants operated with Best Available Techniques (BAT)

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# Best Available Techniques for Waste Incineration

- BREF WI based on the EU-IPPC-Directive
- Integrated, cross-media approach
- Purpose of the Directive is to ensure a high level of protection of the environment taken as a whole
- Important document for the licensing authorities
- **All German WtE-Plants meet the requirements of the BREF WI**

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# BAT air emission standards (BREF WI)

| Substance | periodi-cal value | half-hour average value | daily average value | BAT-Technique |
|---|---|---|---|---|
| Dust | | 1-20 | 1-5 | Fabric filter, electrical precipitator |
| HCl | | 1-50 | 1-8 | Wet / semi dry flue gas cleaning systems |
| $SO_2$ | | 1-150* | 1-40* | Wet / semi dry flue gas cleaning systems |
| NOx with SCR | | 40-300* | 40-100* | High energy consumption and costs |
| NOx with SNCR | | 30-350 | 120-180 | If high raw gas values $NH_3$-Slip is possible, in connection with wet systems preferred |
| TOC | | 1-20 | 1-10 | Optimal combustion conditions |
| CO | | 5-100 | 5-30 | Optimal combustion conditions |
| Hg<br><br>Cd/Tl | <0,05<br><br>0.005 – 0.05 | 0,001-0,03 | 0,001-0,02 | Input-controll/reduction, C-doped Adsorp-tiontechnique |
| PCDD/ PCDF | 0,01-0,1* | | | Optimal combustion conditions, temperatur-controlled reduction of the de-novo-synthese, C-doped Adsorptiontechnique |

Extract of BAT-Table 5.2 “Operational Emission Levels associated with the use of BAT” for air in mg/$Nm^3$

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# BAT water emission standards (BREF WI)

| Parameter | Dimension | BAT- Range | Annex 33 Wastewater Ordinance |
|---|---|---|---|
| Mercury | mg/l | 0,001 – 0,03 | 0,03 |
| Cadmium | mg/l | 0,01 – 0,05 | 0,05 |
| Thallium | mg/l | 0,01 – 0,05 | 0,05 |
| Arsenic | mg/l | 0,01 – 0,15 | 0,15 |
| Lead | mg/l | 0,01 – 0,1 | 0,1 |
| Chromium | mg/l | 0,01 – 0,5 | 0,5 |
| Copper | mg/l | 0,01 – 0,5 | 0,5 |
| Nickel | mg/l | 0,01 – 0,5 | 0,5 |
| Zinc | mg/l | 0,01 – 1,0 | 1,0 |
| PCDD/F | ng TEQ/l | 0,01 – 0,1 | 0,3 |

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# Energy generation and $CO_2$-Savings from WTE-plants in Germany

- Total Energy from WtE: ~ 23 TWh
  - Electric energy ~ 6 TWh
  - Heat energy ~ 17 TWh
- $CO_2$-Savings (Substitution of energy from conventional coal-fired powerplants): 9,75 Mio. t/year
- Potential for increased Energy efficiency
  → additional $CO_2$-Savings of ~ 3 Mio. t/year

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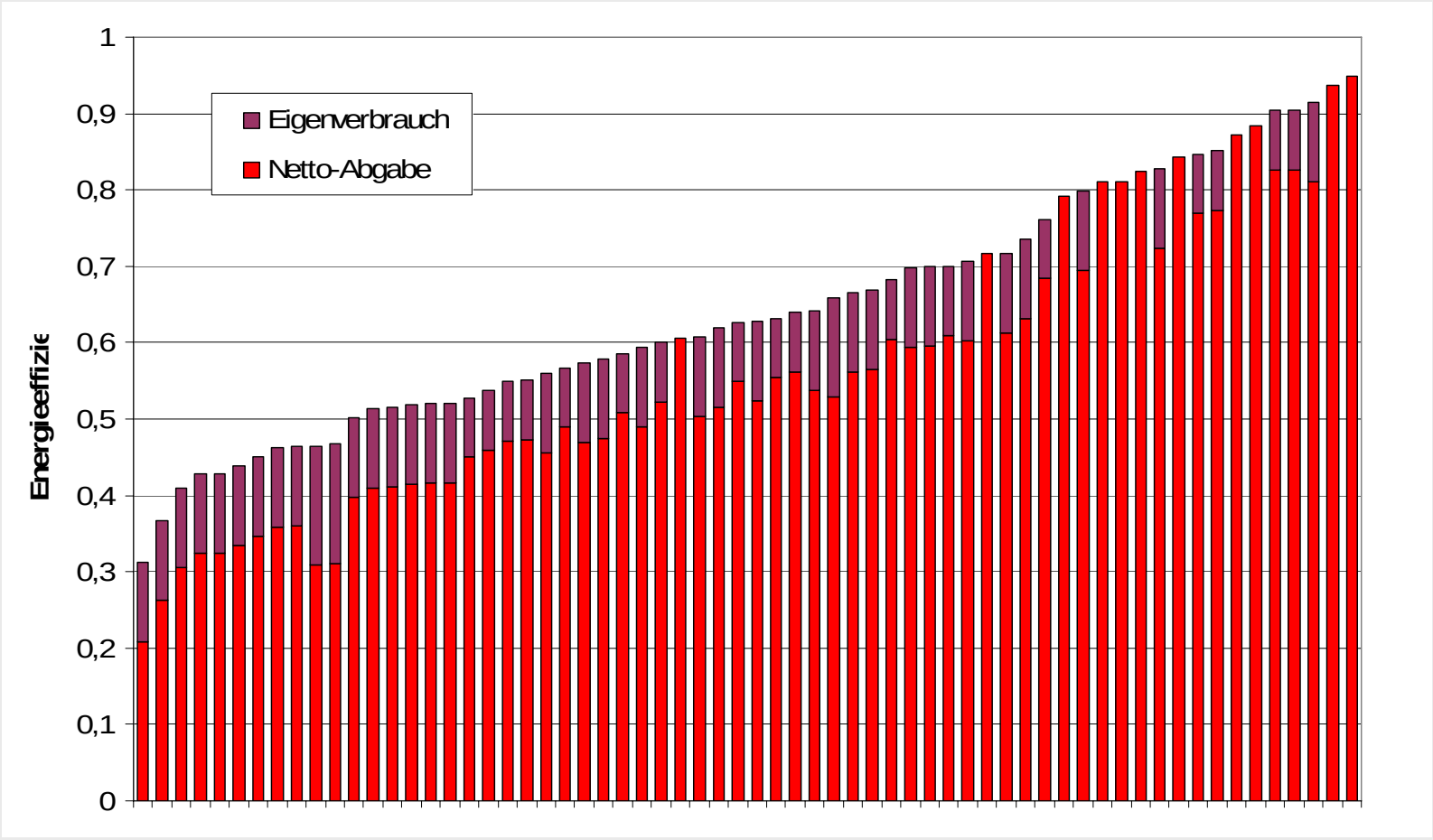
# Energy efficiency of WtE-Plants in Germany



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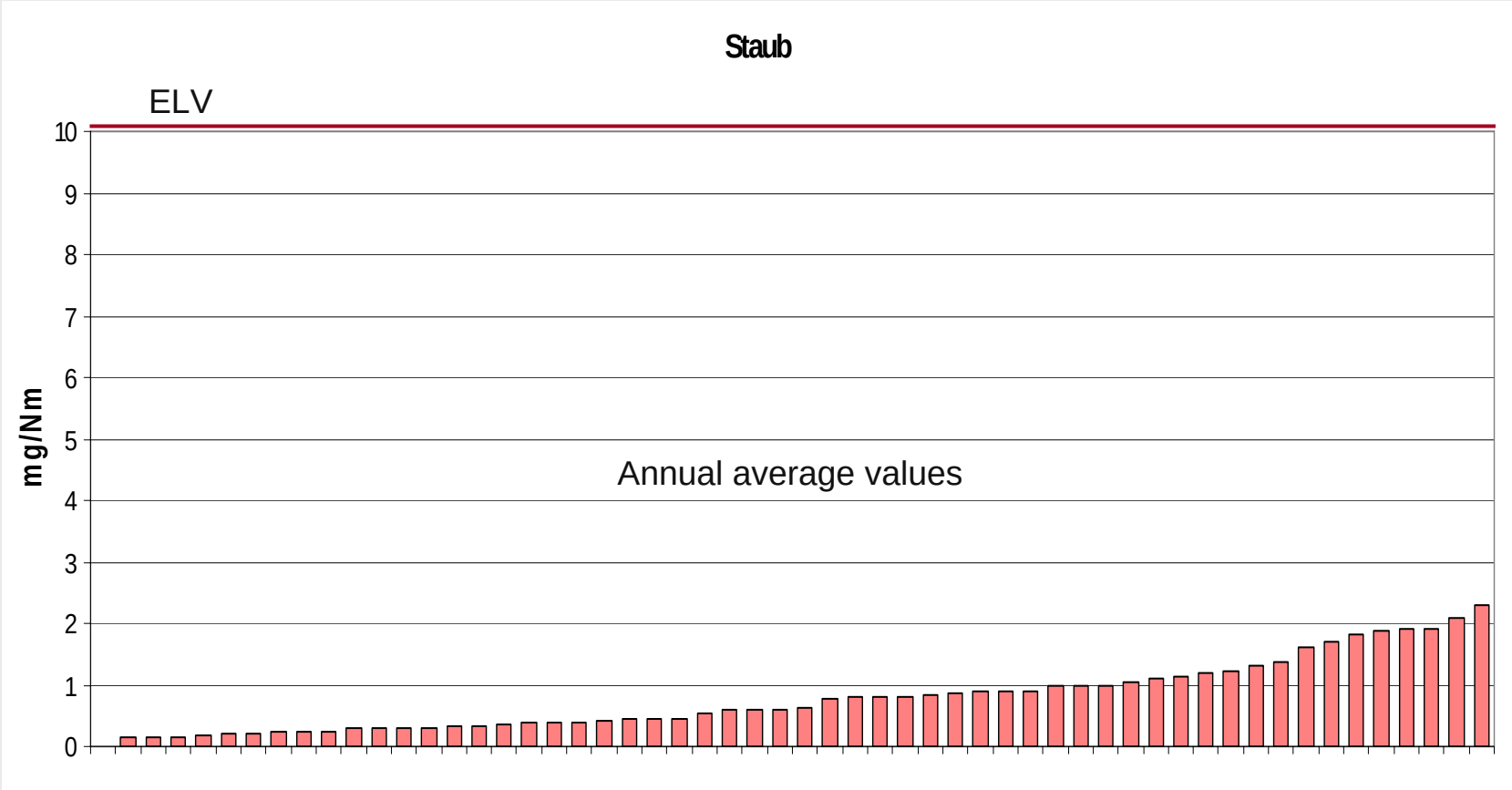
# Emissions of WtE-Plants: Dust



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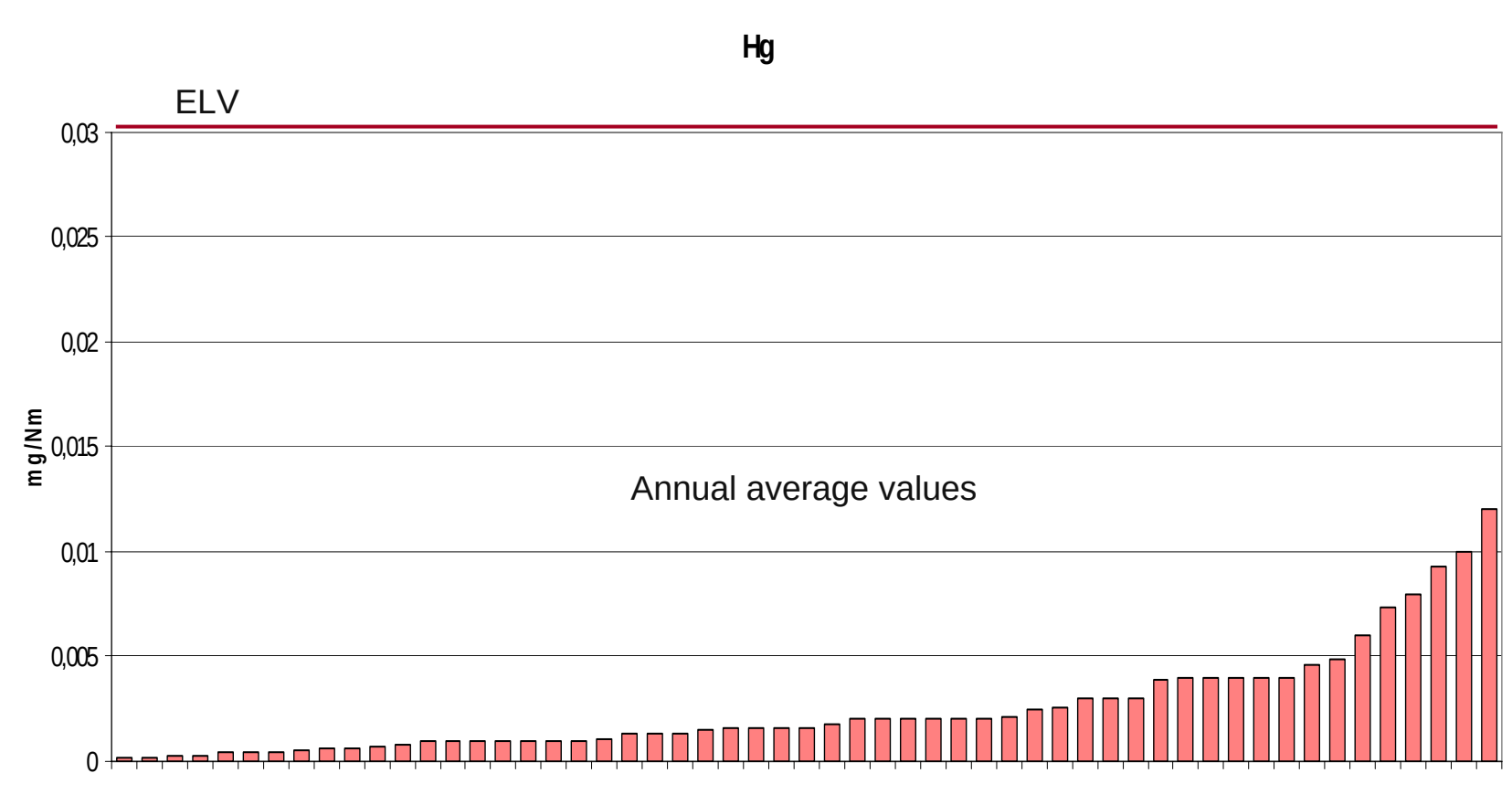
# Emissions of WtE-Plants: Mercury



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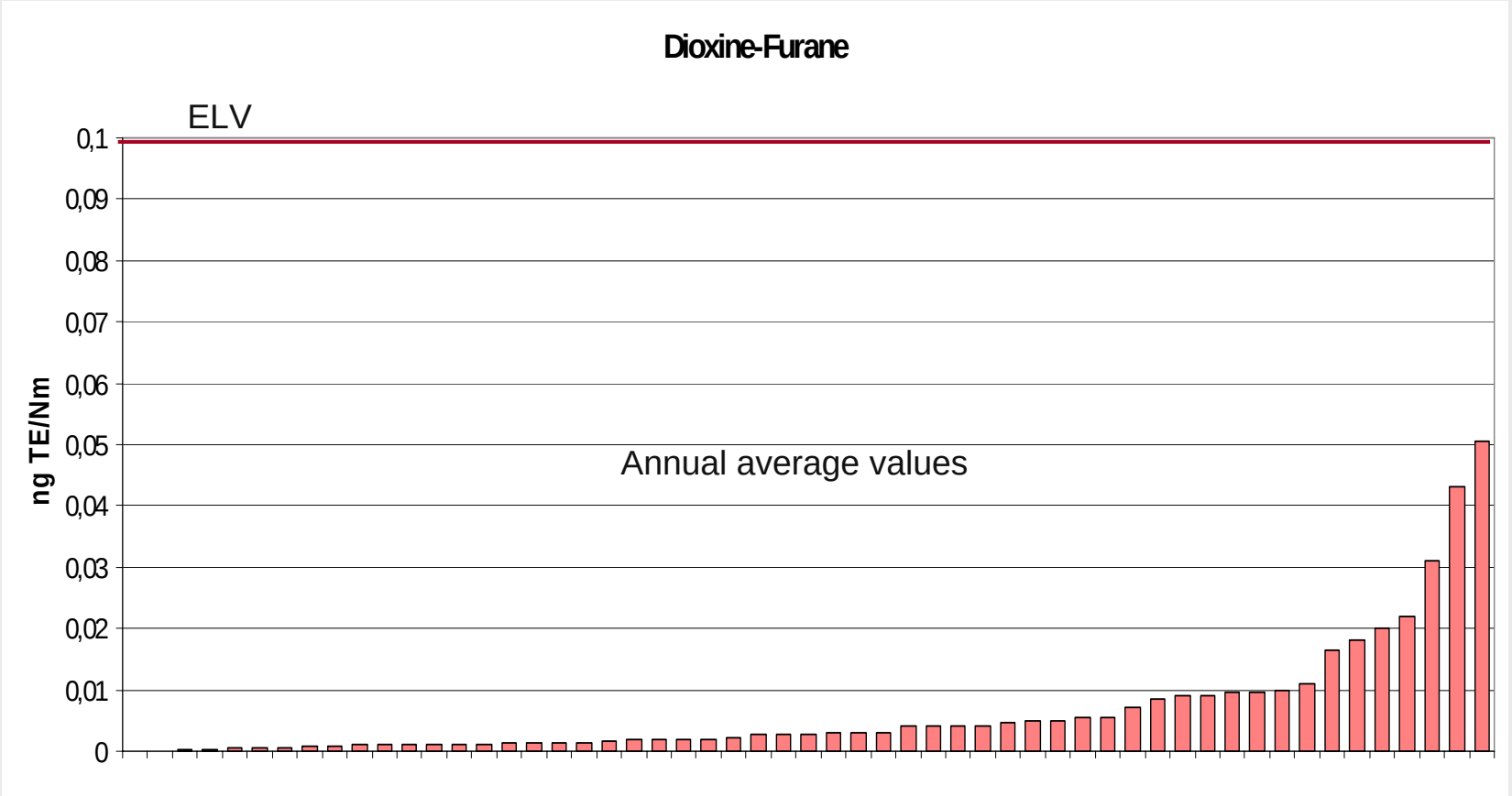
# Emissions of WtE-Plants: Dioxin



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# WtE: Emission Reduction

**WtE: Sink for air pollutants**

- At least 3 tons of arsenic equivalents and 5000 tons of particulate matter would be more in the air in Germany if the energy generated by Waste-to-Energy plants would have been produced by traditional power stations.
- Dioxin emissions dropped to 1/1000 since 1990:

  400 g (1990) → 0,5 g (2000)

  while the amount of waste thermally treated has double

  http://www.bmu.de/english/waste_management/downloads/doc/35950.php
- No significant risk for human health by emission from WtE

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# Emissions of WtE-Plants: Dioxin

"Environment Agency estimates that during the Millennial celebrations in London the emissions from one 15 minute, 35 ton firework display equalled 120 years of dioxin emissions from the SELCHP waste incinerator."

Source: APSWG briefing on Energy from Waste;
UK Environment Agency 2000

CEWEP

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# Conclusions (1)

- Avoid, reuse, recycle and for the rest regard waste as a resource for material and energy recovery
- Dumping untreated waste as landfill is the worst solution
- The waste sector has a large potential for greenhouse gas reduction
- WtE-plants are essential and indispensable element of sustainable waste management: enabling secure disposal and contributing to climate protection
- WtE-plants designed with BAT: any impacts on environment or human health are negligible

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# Conclusions (2)

- Germany and other European countries who have most successfully reduced dependance on landfills have done this by combining:

  - material recycling
  - biological treatment
  - and waste to energy

- Proving that thermal waste treatment goes hand in hand with recycling

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Thank you
for your kind attention!

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