

# Waste incineration



**Paweł Głuszyński**

[pawel@otzo.most.org.pl](mailto:pawel@otzo.most.org.pl)

## Municipal solid waste in CEE in 2015

Country	Generated (kg per capita)	Recycled (%)	Composted (%)	Landfilled (%)	Incinerated (%)
EU 28	476	28,57	16,39	26,63	26,47
Bulgaria	419	19,09	10,26	66,35	2,63
Croatia	393	16,28	1,78	79,43	0
Czech R.	316	25,63	4,11	52,53	17,72
Estonia	359	24,79	3,62	7,24	51,53
Hungary	377	25,99	6,10	53,58	14,06
Latvia	404	22,77	5,94	61,68	0
Lithuania	448	22,99	10,27	54,02	11,61
Poland	286	26,22	16,08	44,41	13,29
Romania	247	5,67	7,29	72,06	2,43
Slovakia	329	7,60	7,29	68,69	10,64
Slovenia	449	46,33	7,57	22,72	17,15

Source: Eurostat, 2017

## Existing MSW / RDF incinerators in CEE

Country	Number of WTE	Capacity t/a	Cement plants (RDF)	Capacity t/a
Bulgaria	1	2300	3	310 000
Croatia	0	0	(3)	?
Czech R.	3	626 000	4	152 000
Estonia	1	180 000	?	?
Hungary	1	420 000	3	?
Latvia	0	0	?	?
Lithuania	1	250 000	0	0
Poland	7	1 019 200	8	1 100 000
Romania	0	0	?	?
Slovakia	2	170 000	5	1 033 884
Slovenia	(1)	(40 000)	(2)	?
<i>Total</i>	<i>17</i>	<i>2 707 500</i>	<i>26</i>	<i>2 595 884</i>

## "Help" is coming...



- | European Commission provides money for development of waste management infrastructure from two funds:
  - § Cohesion Fund (CF) which for the 2014-2020 period concerns 15 countries only: Bulgaria, Croatia, Cyprus, the Czech Republic, Estonia, Greece, Hungary, Latvia, Lithuania, Malta, Poland, Portugal, Romania, Slovakia and Slovenia.
  - § European Regional Development Fund (ERDF) which supports projects in CEE as well as in some well developed countries in Western Europe
  - § Both funds deliver approx. 5 438 914 693 € for various waste management projects in 16 EU countries

## Summary: Allocation of money in CF and ERDF



Project type	Total (€)	CEE (€)
Recycling	2 101 240 628	1 504 695 326
MBT & incineration	2 764 972 256	1 633 486 884
Hazardous waste	572 701 809	443 824 627

## Proposed incinerators in CEE

Country	Number of WTE	Capacity t/a	Other	Capacity t/a
Bulgaria	4	229 040	?	?
Croatia	0	0	(3 x CK?)	?
Czech R.	~ 8	710 041	?	?
Estonia	0	0	?	?
Hungary	1	220 000	RDF + SS	?
Latvia	?	?	?	?
Lithuania	2	385 000	2 SS	?
Poland	34	2 468 946	2 HCW	800+
Romania	1	350 000	xx HCW	?
Slovakia	0	0	0	0
Slovenia	0	0	0	0
<i>Total</i>	<i>53</i>	<i>4 663 027</i>	<i>&gt; 9</i>	<i>?</i>

# Arguments against waste incineration

1. Investment and operational costs vs. alternatives
2. Jobs created in comparison with other waste management options
3. Emissions: what is monitored daily, what periodically, what pollutants are not regulated at all
4. Solid and liquid waste don't disappear
5. Impact on climate change - GHG emissions in comparison with alternative scenarios
6. Waste to Energy or wasted energy?
7. Zero Waste and Circular Economy vs. waste incineration, including:  
<http://ec.europa.eu/environment/waste/waste-to-energy.pdf> and RED
8. *Upcoming BAT BREF?*



- Investment costs very much depend on the scale of installations – the larger the plant the lower the costs calculated per treated ton of waste
- It is believed that incineration plants with a throughput lower than 100,000 tonnes per annum are uneconomical
- Average investment costs (20,000 – 100,000 t/a) €/t:

Sorting line	MBT	MRBT	Composting plant	Anaerobic digestion	Incinerator
34 - 250	238	357	118 - 196	50 - 350	895 - 1130

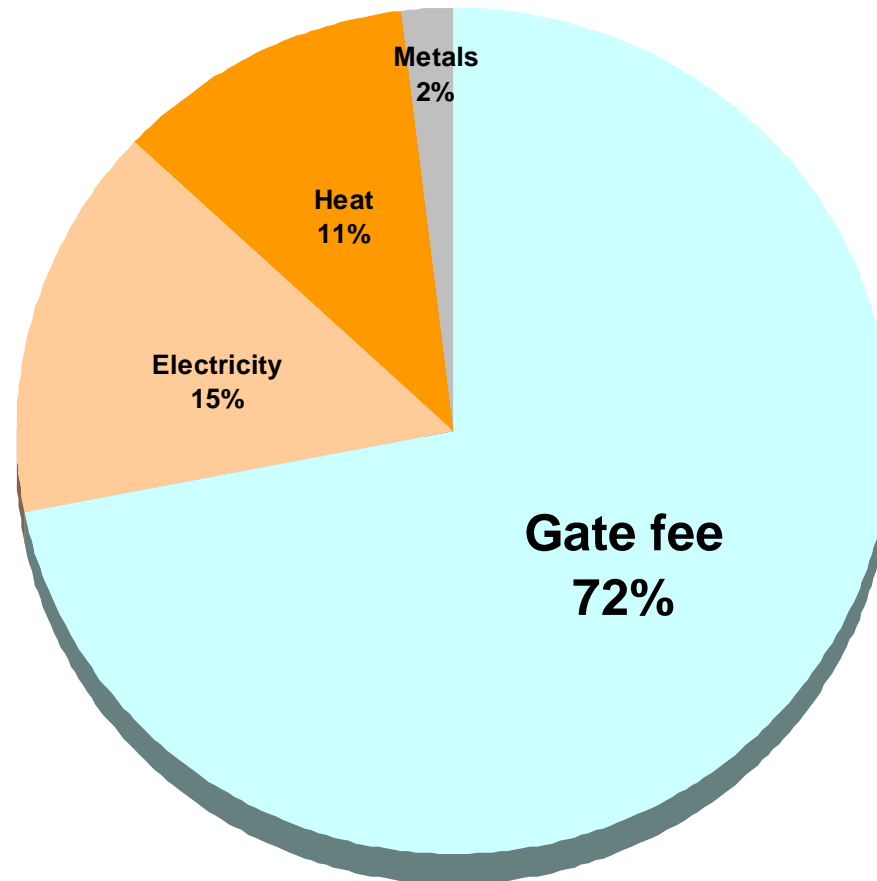




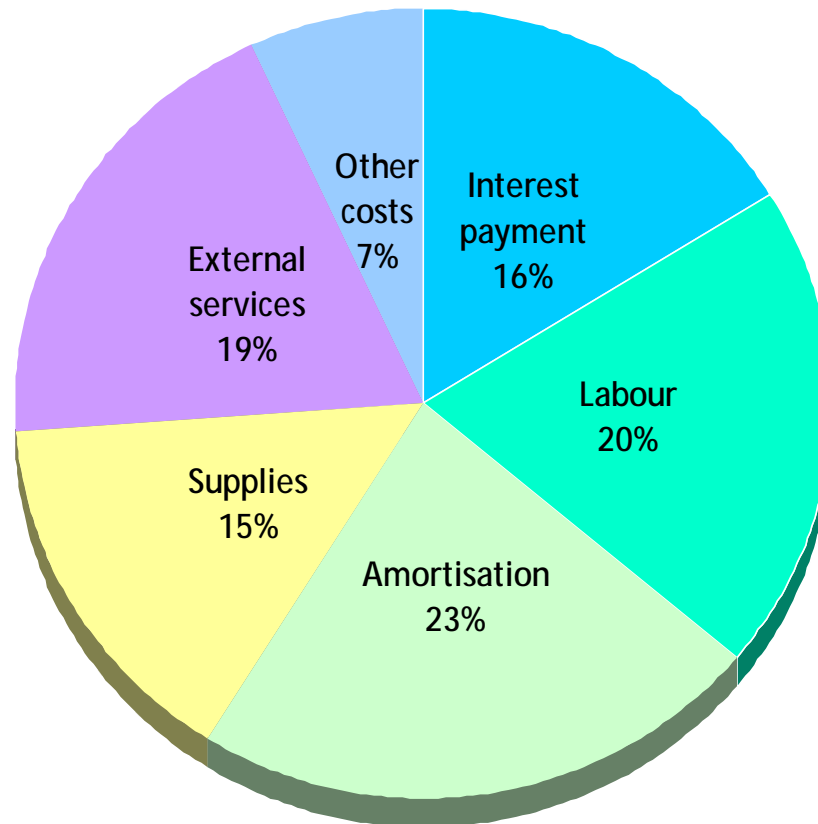
- Like the investment costs, operational very much depend on the scale of installations – the larger the plant the lower the costs calculated per treated ton of waste
- Average operational costs (20,000 – 100,000 t/a) €/t, excluding sale of installation's product like raw materials, compost, energy:

Sorting line	MBT	MRBT	Composting plant	Anaerobic digestion	Incinerator
40 - 68	48 - 128	51 - 128	34 - 91	30 - 90	69 - 120

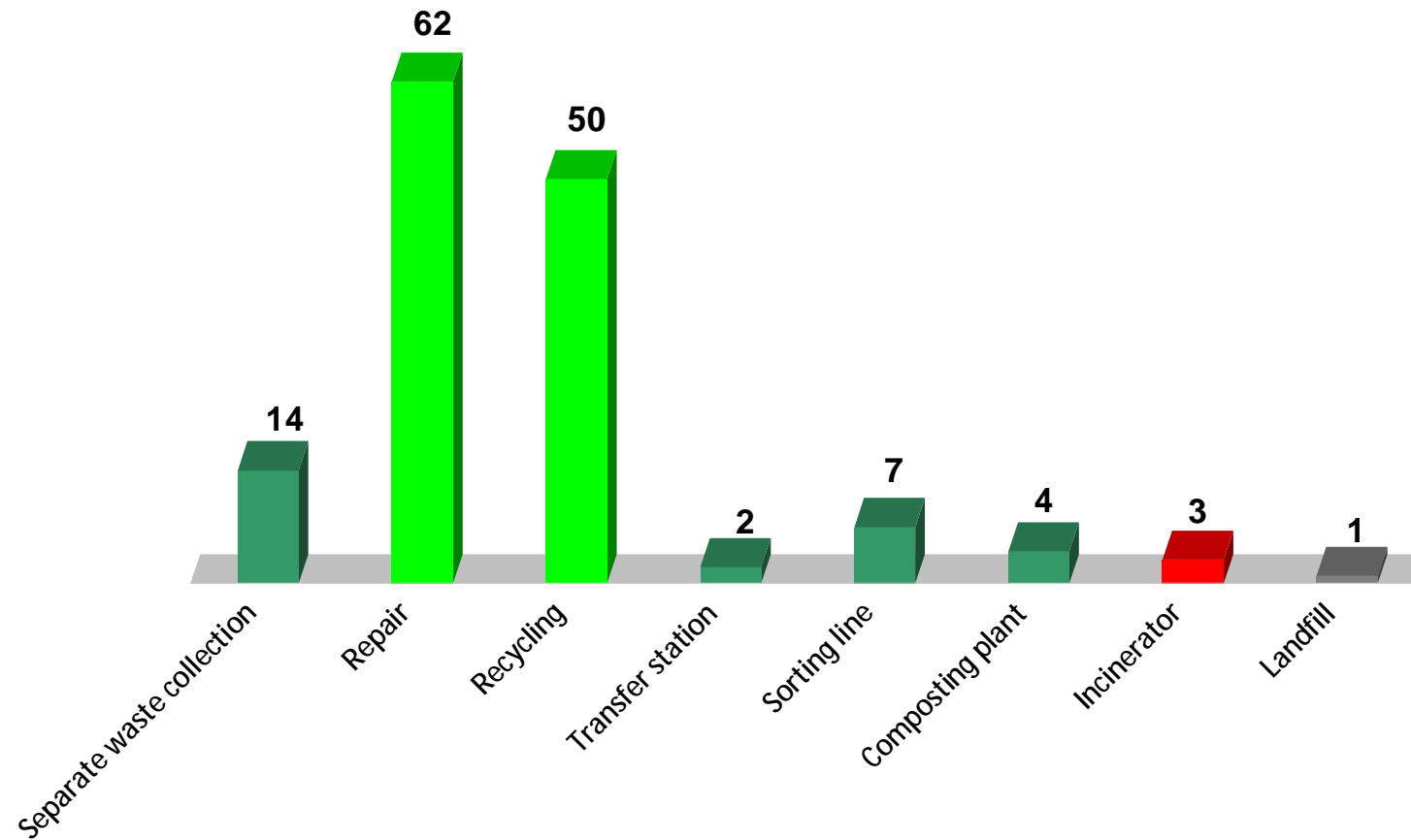
# Typical structure of incomes of an incinerator



# Typical breakdown of costs of an incinerator

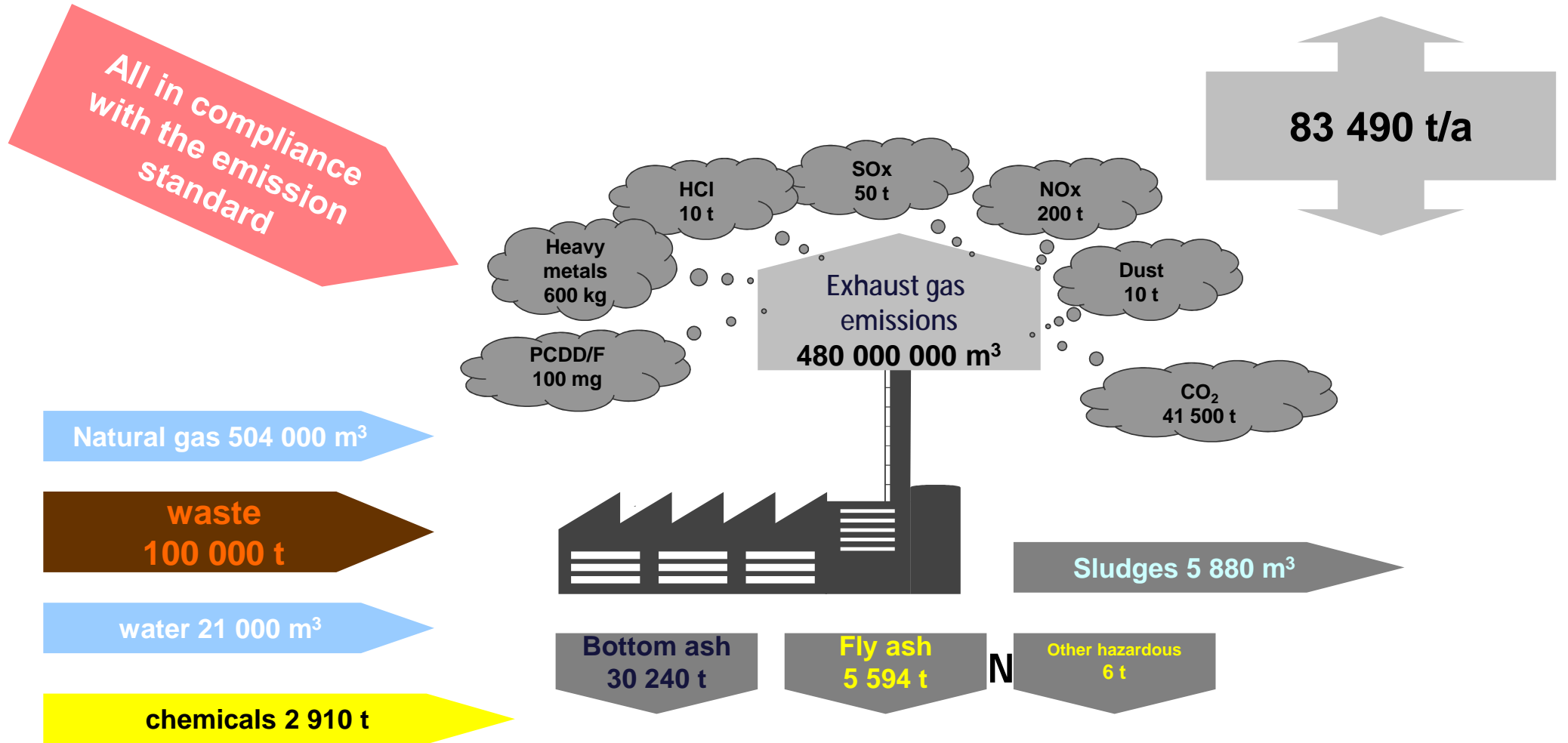


# Number of jobs created per 10 000 tons of MSW handled



Source: ADEME, 2009; ILSR, 2010.

# Mass balance of a modern waste incineration plant (100,000 t/a)

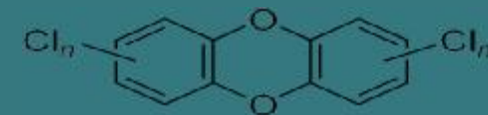


## Emission monitoring



- | Mixed municipal waste are not homogenous and the stream may vary substantially per load, and may include waste having hazardous properties
  
- | Continuous monitoring does NOT includes heavy metals, dioxins and furans
  - § Emission test may not reflect real and changing conditions
  - § *There is possibility to 'optimise' emission test*
  
- | Continuous monitoring includes only:
  - § Dust, TOC, CO, HCl, HF, NO<sub>x</sub>, SO<sub>2</sub>

# Underestimation in dioxin emissions



<i>Date of measurement</i>	<i>PCDDs/Fs ng TEQ/Nm<sup>3</sup> (11% O<sub>2</sub>)</i>	
	<i>Continuous</i>	<i>6 hours</i>
29.11.97 – 12.01.97	13.4	Not measured
12.01.98 – 26.01.98	8.2	0.25
26.01.98 – 30.01.98	12.6	Not measured
09.02.98 – 23.01.98	2.11	Not measured
23.02.98 – 09.03.98	0.44	Not measured
09.03.98 – 23.03.98	0.33	0.12
23.03.98 – 06.04.98	0.8	Not measured

Source: R. De Fré, M. Wevers, Underestimation in dioxin emission inventories, *Organohalogen Compounds*, Vol. 36 (1998)

# "State of the Art" in Germany

Incinerator (Bavaria)	Exceedances in limit values in 2011
Augsburg	SO <sub>2</sub> , CO
Bamberg	CO, dust
Burgau	SO <sub>2</sub> , HCl, NO <sub>x</sub> , CO, Hg, dust
Coburg	CO, TOC
Geiselbullach	SO <sub>2</sub> , HCl, CO, Hg, TOC
Ingolstadt	SO <sub>2</sub> , NO <sub>x</sub> , CO, TOC, dust
Kempten	SO <sub>2</sub> , NO <sub>x</sub> , CO, TOC, dust
München-Nord	SO <sub>2</sub> , NO <sub>x</sub> , CO
Nürnberg	CO, dust
Rosenheim	CO, NH <sub>3</sub>
Schwandorf	SO <sub>2</sub> , HCl, CO, dust
Schweinfurt	SO <sub>2</sub> , NO <sub>x</sub> , CO, TOC
Weissenhorn	SO <sub>2</sub> , CO, dust
Würzburg	SO <sub>2</sub> , HCl, CO, Hg

Issues with CO and TOC exceedances mean that elevated dioxins & furans release could occur

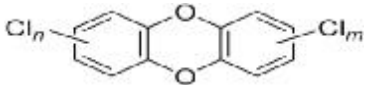


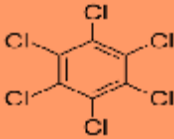
Source: Bayerisches Staatsministerium für Umwelt und Verbraucherschutz, 2012; dr Hartmut Hoffmann.





# Not regulated emissions

Brominated  
dioxins &  
furans?!

Pollutant ng [TEQ]/Nm <sup>3</sup> (11% O <sub>2</sub> )	Czech Republic Břeclav	Poland Kraków	Poland Eko-Top
PCDDs/Fs 	0.91	1.48	0.081
PCBs 	0.01	86.5	16.15
PAH 	0.312	Not analysed	Not analysed
HCB 	10.28	31.7	12.2

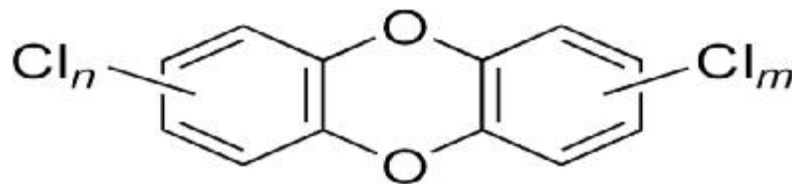
Sources:

dr J. Petřík, Arnika, Hazardous waste incineration in the Czech Republic, International Workshop on Non-Combustion Technologies for Destruction of POPs, Prague 2003.

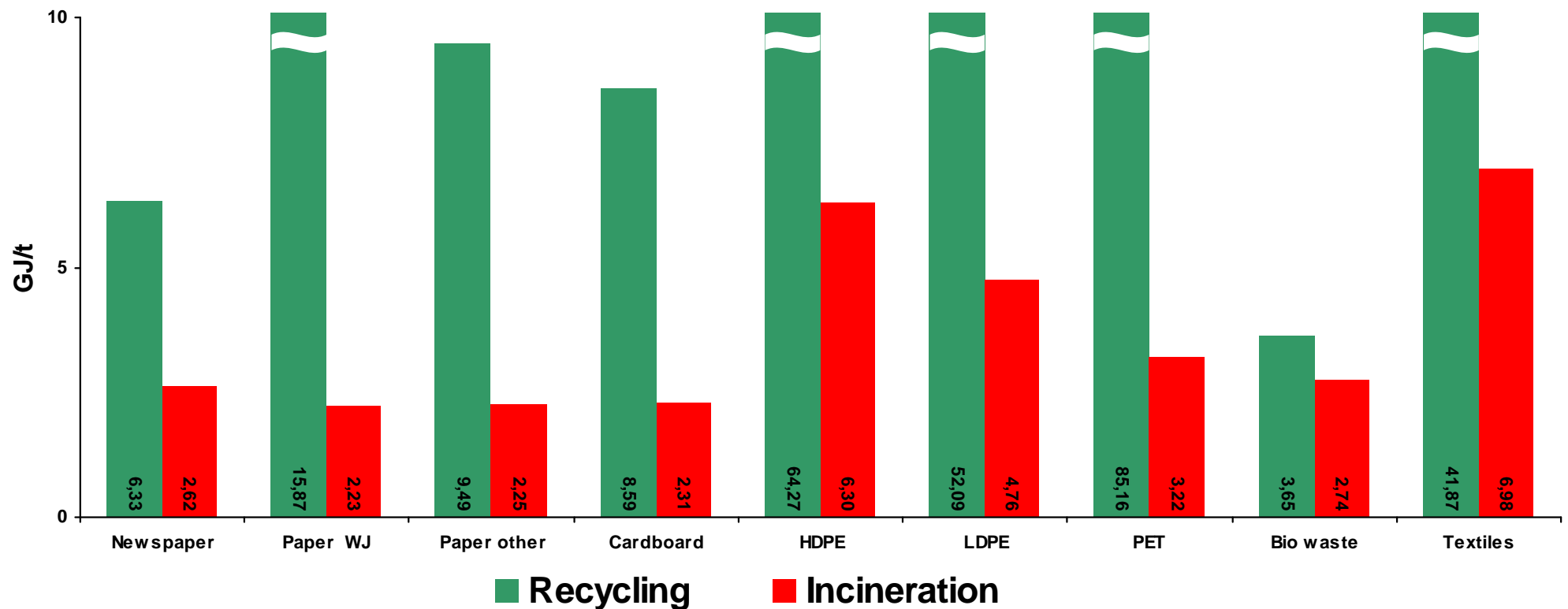
Grochowalski A., Sprawozdanie z przeprowadzonych pomiarów i oznaczania stężenia PCDDs/PCDFs, HCB i PCBs, 30.09.2002

## Confirmed adverse health effects associated with emissions from waste incineration

- Incidence of rare and very serious forms of malignant cancer like sarcoma and non-Hodgkin's lymphoma, and more frequent gastric and lung cancer;
- Decreased the overall immunity and the associated increased and often chronic incidence of common diseases such as cold, bronchitis, pneumonia, headaches, various allergies;
- Increased neurologic symptoms, including tingling, blackouts, incoordination, memory problems, erratic blood pressure.



# Energy saved by recycling vs energy generated by incineration [GJ/t]



Source: J. Morris, 2005

# Impact of waste treatment methods on climate



- | Most typical waste treatment or disposal methods are not carbon neutral:
  - § Open windrow composting  $\dot{U}$  50 kg CO<sub>2</sub> eq/t
  - § Mechanical-biological treatment (MBT)  $\dot{U}$  150 kg CO<sub>2</sub> eq/t
  - § Incineration  $\dot{U}$  321 - 455 kg CO<sub>2</sub> eq/t
  - § Landfill without off-gas treatment  $\dot{U}$  986 kg CO<sub>2</sub> eq/t
  - § Landfill with off-gas treatment  $\dot{U}$  640 kg CO<sub>2</sub> eq/t



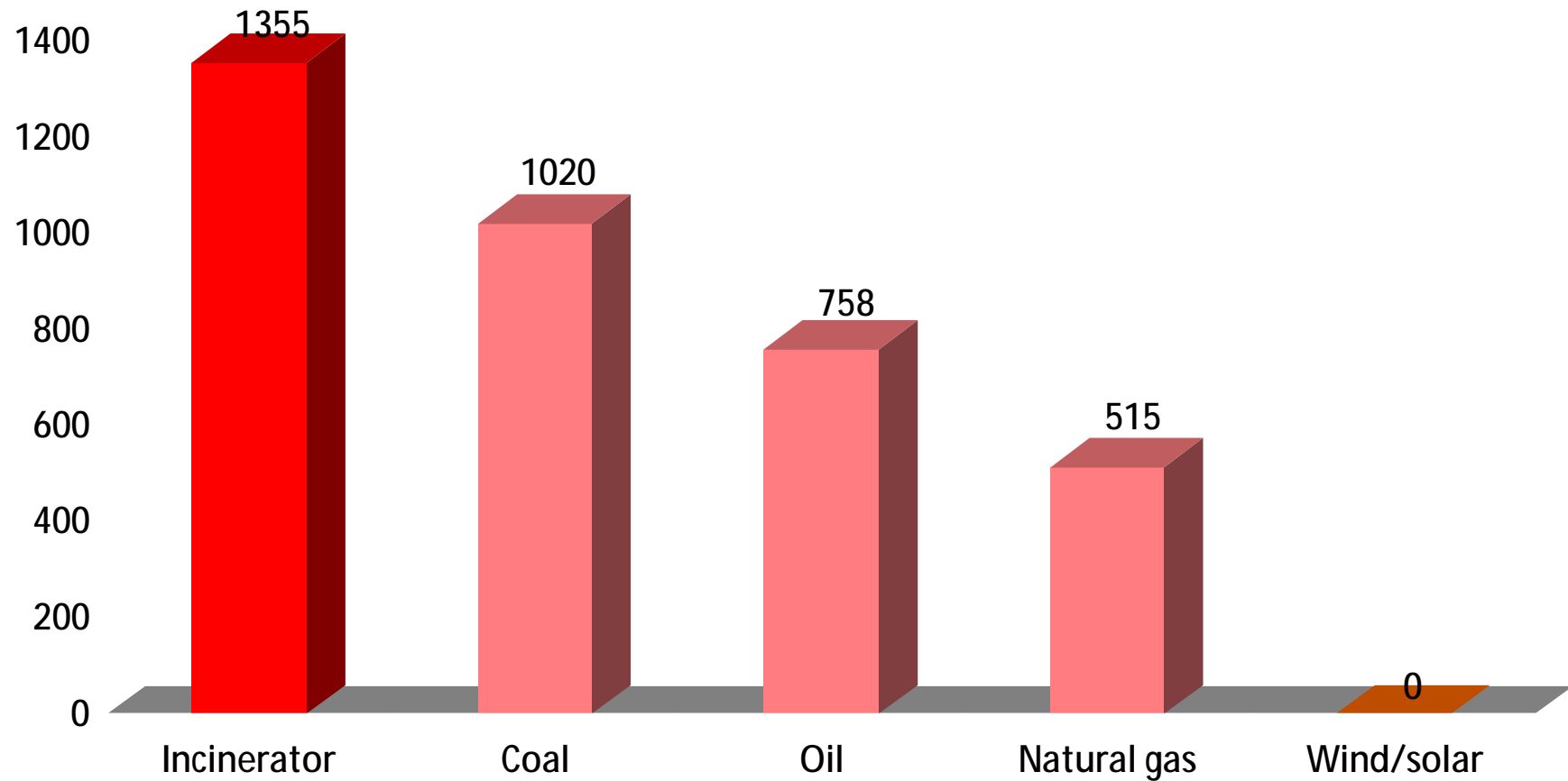
## Reduced GHG emission



- | There are also methods that allow to reduce the potentiality of GHG emission thankful of gas capture and its utilisation or conservation of energy contained in a material thus significant decrease of virgin material extraction and processing:
  - § In-vessel composting  $\ddot{U}$  -50 kg CO<sub>2</sub> eq/t
  - § Anaerobic digestion (fermentation)  $\ddot{U}$  -50 kg CO<sub>2</sub> eq/t
  - § Recycling  $\ddot{U}$  -106 up to -12,868 kg CO<sub>2</sub> eq/t



# CO<sub>2</sub> emission by power plant type per kilowatt-hour of power generated [g CO<sub>2</sub>/kWh]

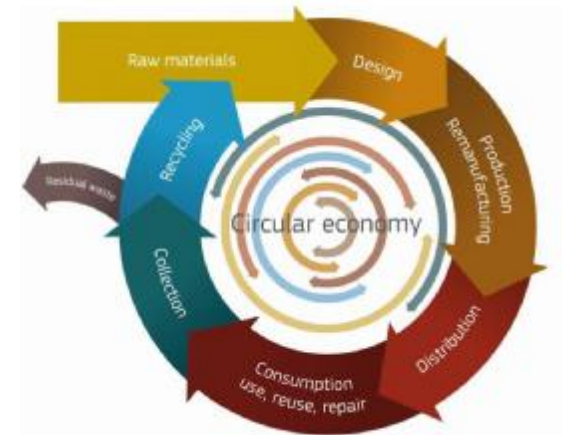


Source: US EPA

# Paradigm change: Circular Economy



- On December 2<sup>nd</sup>, 2015 European Commission has started negotiation of a package of strategic legislation called Circular Economy
- Its aim is to change linear economy into circular one by closing the loop of a product life cycle - starting from extraction of virgin materials, design, production, use, recovery and recycling when it becomes *waste* (secondary raw material)
- It should strengthen and make more coherent implementation of compliance in products policy, guidance on industrial emissions, consumers protection against unfair practices, interface between chemicals, products and waste legislation

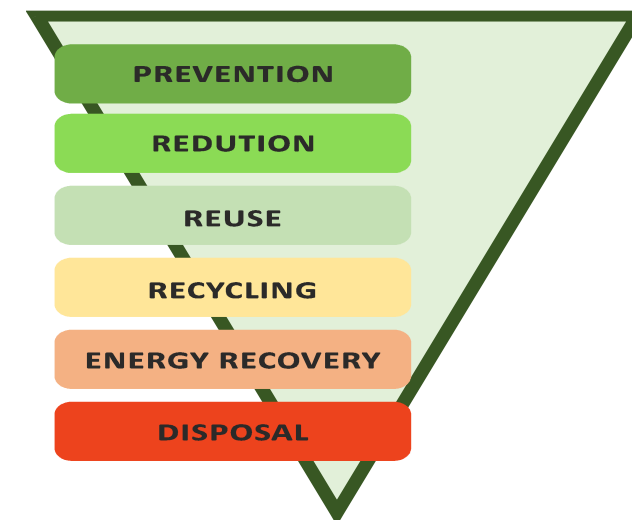


- Slow**  
long life of products
- Tight**  
no superfluous use of resources, and waste generation
- Local**  
territorial hierarchy
- Clean**  
non toxic

## Proposed new targets



- | As yet, the most defined targets concern municipal solid waste:
  - § by 2025 60% recycling of MSW, and 65% of packaging
  - § by 2030 65% recycling of MSW, and 70% of packaging
  - § by 2030 max 10% landfilling of MSW
  - § ban on disposal of recyclable waste
  - § *limit of waste incineration up to 30%*
  
- | Separate collection of bio-waste *where technically, environmentally and economically practicable*
  
- | By 2030 reduction of (plastic) marine litter, and food waste [*both by 50% from 2014 levels*]
  
- | *Overall waste prevention target?*





## Important statements by the European Commission



- | *Public funding should also avoid creating overcapacity for non-recyclable waste treatment such as incinerators. In this respect it should be borne in mind that mixed waste as a feedstock for waste-to-energy processes is expected to fall as a result of separate collection obligations and more ambitious EU recycling targets. For these reasons, Member States are advised to gradually phase-out public support for the recovery of energy from mixed waste.*

[The role of waste-to-energy in the circular economy, COM\(2017\) 34 final](#)

and

- | *[...] funding for new facilities for the treatment of residual waste, such as incineration or mechanical biological treatment, will be granted only in limited and well justified cases, where there is no risk of overcapacity and the objectives of the waste hierarchy are fully respected.*

[Closing the loop - An EU action plan for the Circular Economy, COM\(2015\) 614 final](#)

# CE / ZW: Mission impossible?



Town / region	Recycling level before introduction of a ZW program	Reached recycling level	Time needed
Lublana 380k inhabitants	45%	60% 15% waste reduction	24 months
Salerno 145k inhabitants	18%	72%	12 months
Treviso (region) 554k inhabitants	27%	66%	18 months
Capannori 46,7k inhabitants	50%	90% 39% waste reduction	84 months
Novara 101k inhabitants	29%	70%	18 months
Gipuzkoa (region) 732k inhabitants	32%	51 – 81 % 7% waste reduction	48 months
Parma 190k inhabitants	48%	72% 15% waste reduction	36 months
Horst aan de Maas 41k inhabitants	73%	94%	12 months

Waste incineration  
has no future



TNZ