



Doosan Lentjes

Waste-to-Energy in Krakow -
The Successful Role Model
for the Application of Thermal
Waste Treatment in Sofia

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Български Енергиен & Минен Форум
Bulgarian Energy & Mining Forum

International Conference WASTE-TO-ENERGY
- TECHNOLOGIES, PROJECTS, NEW OPTIONS FOR MUNICIPALITIES AND BUSINESS

German engineering and technology solutions since 1928

Doosan Lentjes is a global provider of processes and technologies for energy production from renewable and fossil fuels.

We are a technology company with in-house proprietary processes - our areas of expertise include:

- Circulating fluidised bed technologies (CFB)
- Waste-to-Energy (WtE)
- Air pollution control technologies (APC)

Doosan Lentjes is the global center of competence for CFB, WtE and APC within Doosan and has its own R&D center for these technologies.



Waste-to-Energy Plant References

Location: Krakow, Poland
Customer: Posco
Final Customer: KHK
Process: Counter-reciprocating grate
Throughput: 2 x 110,000 t/a (MSW)

Location: Harlingen, the Netherlands
Customer: REC B.V. (subsidiary of Afvalsturing Friesland N.V. ("Omrin"))
Process: Counter-reciprocating grate (water-cooled)
Throughput: 1 x 280,000 t/a (MSW)

Location: Frankfurt, Germany
Customer: AVA Nordweststadt
Process: Counter-reciprocating grate
CIRCOCLEAN® flue gas cleaning
Throughput: 4 x 160,000 t/a (MSW)



Why Waste-to-Energy?



Waste volume reduced by 90 %



Space demand for landfill sites

Material recovery (Metals, construction material)



Wasting resources

Protect environment (Minimum gas / odour emissions)



Landfill emissions (Odour, methane, leachate)

Produce renewable energy
Electrical power



Wasting energy resources



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Key Data of CEE Countries



Country	Inhabitants 2011 (Mio.)	GNP 2011 (Mrd. Euro)	GNP per Capita 2011 (Euro)	Municipal Waste generated (kg/person)	Municipal Waste generated (mio t/a)
Bulgaria	7,6	38,5	10.178	460	3,50
Croatia	4,4	64,2	14.545	391	1,72
Poland	38,2	369,7	16.258	314	11,99
Romania	21,5	136,5	9.975	389	8,36
Slovakia	5,4	69,1	18.400	324	1,75
Slovenia	2,0	36,2	21.300	362	0,72
Czech Republic	10,5	156,2	20.200	308	3,23
Hungary	10,0	99,8	16.400	402	4,02
Europe Total	505,5	12.568,6		492	248,71
CEE as above	99,6	970,2		369	35,30
Germany	81,8	2.592,6	30.300	611	49,98
Macedonia	2,0	17,1	8.288	381	0,76
Montenegro	0,6	5,7	9.230		
Serbia	7,5	63,1	8.509	364	2,73
Turkey	75,9	858,4	11.606	390	29,60

Source: Wikipedia, Eurostat, author's calculation

- Poland and Hungary produce ~65% of the waste of the '2004 member states'
- CEE countries generate ~15% of EU waste with ~20% of its inhabitants



Bulgaria

- A very large proportion of the municipal waste is landfilled in Bulgaria. The amount of municipal waste deposited into landfills was 98 % of the generated amount in 2010.
- It must be stressed that Bulgaria will need to make an exceptional effort in order to fulfil the 50 % target of the Waste Framework Directive by 2020.
- No WtE plants in operation
- Projects in development, applied for EU financing



Source: ETC/SCP Working Papers, European Environment Agency (EEA) 2013



Czech Republic

- 3 WtE plants in operation
 - Liberec 96.000 tpa (1999)
 - Brno 224.000 tpa (1989, retrofitted)
 - Praha (Malesice) 310.000 tpa (1998)
- 630.000 tpa = ~20% of generated MSW
- 1 WtE plant construction halted (Plzen/Chotikov 95.000 tpa)
 - Further projects slowly in development



Hungary

- 1 WtE plant in operation
 - Budapest 450.000 tpa (2006) = ~11% of generated MSW
- Little activities for new WtE projects



Romania

- 1 WtE plant contract on hold (Timisoara 78.750 tpa)
- Further projects in development



Slovakia

- 2 WtE plants in operation
 - Bratislava 135.000 tpa (1978)
 - Kosice 80.000 tpa (~1990)
- 215.000 tpa = ~11% of generated MSW
- No activities for further WtE projects

Poland

- 1 WtE plant in operation (Warsaw 57.000 tpa)
- 6 new WtE completed
- Further projects in development





- In the mid 1990s one of the first waste management related conferences took place:
 - Discussions about introducing an orderly and environmentally sound waste management structure
 - Consensus that waste incinerators should become a substantial part of waste management with a significant market potential
 - Significant amounts of waste available (12-15 mio t/a)
 - Realisation of projects should be coming soon....
- When Poland joined the European Union on 1st May 2004 this development was eventually significantly accelerated
- In the past 3 years numerous new plants have been realised
- Two decades from the development of first ideas until the commissioning of plants



There was only one publically operated WtE plant, located in Warsaw (start-up 2001):

- Incineration capacity: 57.000 t per year, actual load approx. 75 % because of technical problems and high gate fees
- Gate fee for energetic recovery 78-91 EUR/t (for municipal solid waste)
- Landfilling is the main route for disposing waste (>80%)
- Local authorities had only limited control of waste disposal
- In October 2005 the rules of the EU were ultimately adopted into Polish waste legislation with transition periods for their implementation incl. ambitious recycling targets



- 2007 Indicative List for WtE-Projects: Start project development and secure EU funding
- 2008 Introduction of the Marschall Fee:
- Fee for landfilling waste (landfill tax)
 - Steering of waste streams
 - Teaser for waste producers to promote their environmentally friendly behaviour
 - Increase of landfill gate fees from approx. 15 PLN (2006) to 200 PLN (2015)
- 2011 Law “Act on maintaining cleanliness and order in municipalities“:
- Transfer ownership of waste to public waste management companies
 - Local authorities to tender services in the field of waste management
 - Levy taxes in order to cover cost of waste disposal (7 PLN / person / month), rather low to set up a sensible system including also relevant sorting
 - Prohibition of storage of waste outside the waste management region



WtE plants were constructed in the following cities/municipalities:

▪ Poznan	210.000 t/a	PPP
▪ Szczecin	150.000 t/a	666,2 mio PLN (gross)
▪ Bydgoszcz	180.000 t/a	491,7 mio PLN (gross)
▪ Bialystok	120.000 t/a	409,5 mio PLN (gross)
▪ Konin	94.000 t/a	364,1 mio PLN (gross)
▪ Krakow	220.000 t/a	<u>796,9 mio PLN (gross)</u>
		2.728,4 mio PLN (gross)

- Commissioning and completion until end of 2015 except Poznan (PPP)
- Total investments approx. 680 mio. EUR
- Thermal treatment capacities of approx. 1 mio. t/a were awarded (<10% of the amount generated in Poland)



- KHK S.A. (Krakowski Holding Komunalny AG) is the for the entire project execution responsible authority, KHK SA is a 100% subsidiary of the City of Krakow
- General contractor Posco E&C (South Korea) in cooperation with Doosan Lentjes as technology provider
- General design features
 - Plant with 2 lines á 14,1 t/h capacity, design LHV 8,8 MJ/kg
 - Infrastructure of the plant, in addition with installations for
 - Bottom ash treatment (70.000 t/year)
 - Treatment of FGC residues from (15.000 t/year)
 - Beside the connection to the grid also a connection to the local district heating is foreseen



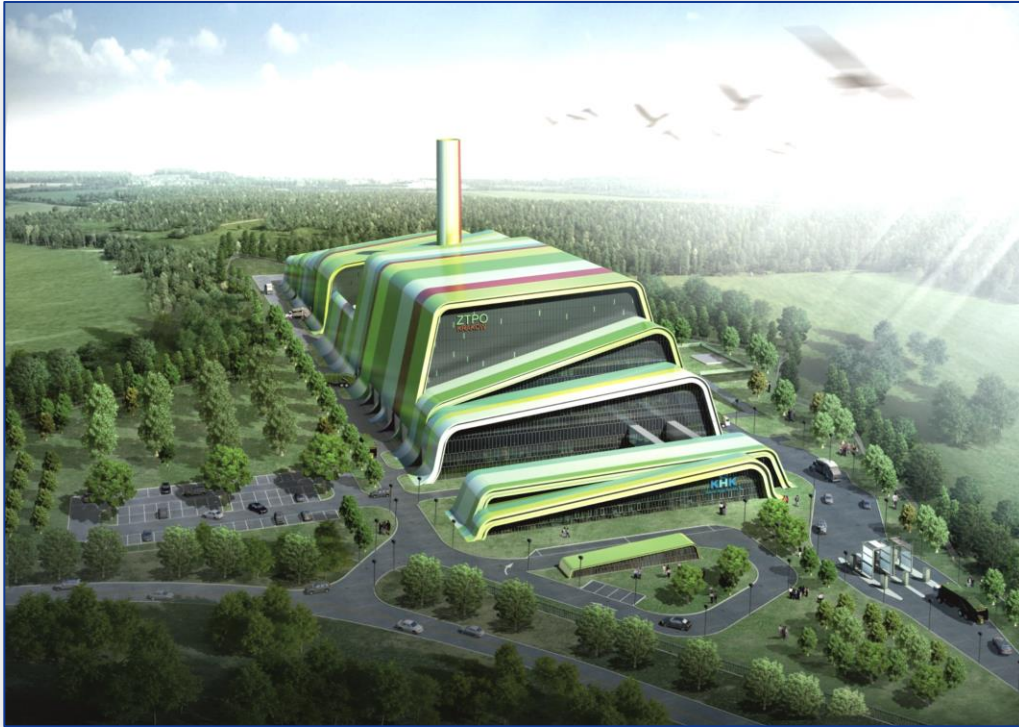


- Between the RFQ issuance and contract signature there was a period of about one year
- Total project execution period
1.100 days / ~36 months,
200 days for permit process (real 1 year)
900 days for building (red. to 24 months)
- Contract value
647.904.000 PLN (net)

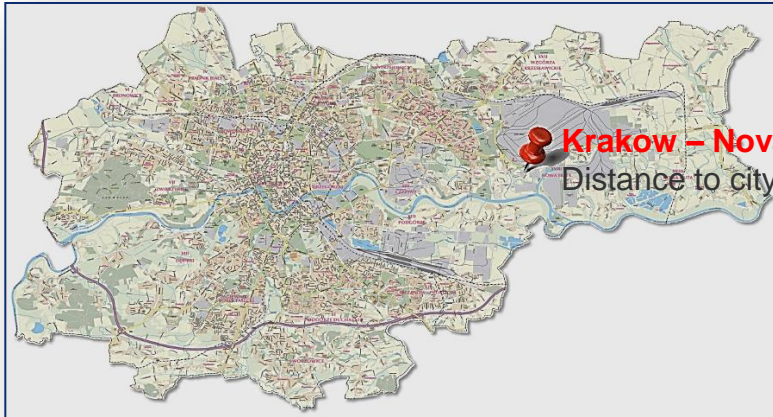
The WtE Krakow Architecture



“A modern ribbon as part of the landscape and the natural environment
- inspired by the arrangement of fields, flowers and colors of the region“



Plant Site



Krakow - Nova Huta
Distance to city center approx. 12 km





Power generation gross 10,47 / 16,19 MWe

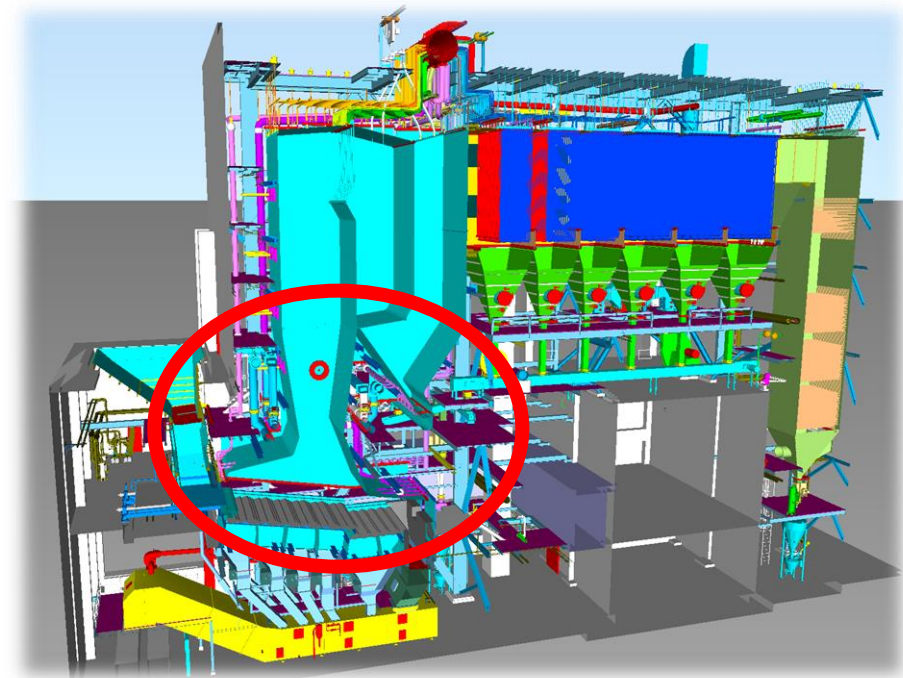
Feed-in of district heating 35 / 0 MW_{th}

- The produced electrical energy of the WtE plant Krakow covers the annual demand of the Krakow street cars or the street lighting
- The produced amount of heat covers approx. 10% of the Krakow heat demand
- 42% of the energy coming from WtE plant Krakow count as renewable energy





- WtE plant is designed conventionally featuring the prefixed 2 line concept
- Annual capacity 220.000 t at the design point (2x14,1 t/h - 8,8 MJ/kg)
- Maximum annual capacity approx. 250.000 t
- Tender's minimum requirements
 - Steam parameters 40 bar / 415 °C
 - Boiler efficiency >85 %
- Boiler feedwater temperature 130 °C
- T_{RG} behind boiler should be 180°C
- Steam flow approx. 2x40,3 t/h



Doosan Lentjes air cooled reciprocation grate system

Current Site Status WtE Krakow Project





- Create a waste management infrastructure stability
- Capability and willingness to take decisions (leadership)
- Professional project organisation and strong planning
- Sound project basics (waste arisings, financial instruments)
- Proper site selection
 - The site selection process strongly influences the public's attitude towards an WtE plant
 - Each WtE project is perceived by the residents as a risk for their own personal „micro world“
- Clear responsibilities and cooperation between government levels
- Sound legislation, jurisdiction and competent authorities
- Technology selection based on proven WtE systems
 - Design capability must be of highest priority
 - Consider future waste arisings and qualities
 - Apply simple and reliable processes with proven references
 - No prototype technologies



- So called 'innovative' or 'Advanced' Conversion Technologies (ACT) like pyrolysis, gasification or plasma do not represent a sustainable solution:
 - Process development for MSW not completed
 - No large scale experience available
 - No clear heat and mass balances publically available
 - No proven economics
 - No proven technology
- Beyond prevention, reuse and recycling there are no alternatives to traditional grate based incineration
- For more than 50 years grate based Waste-to-Energy plants contribute worldwide to a safe and environmental friendly disposal of municipal solid waste
- Highly efficient supply of electricity and heat
- WtE is not in contradiction to recycling



- In the CEE region Poland is the leading country in introducing waste management measures
- In Poland it took two decades from the development of ideas until the commissioning of first modern plants
- In Poland a market with major potential has been created by forward-looking waste management measures and investments
- The waste-to-energy technology will play a major role in a safe and environmental friendly waste management concept
- The CEE region will be an important market with significant potential for waste-to-energy plants
- The Krakow WtE project is the successful role model for the application of thermal waste treatment in Sofia, similarities in structure, financing requirements and need for a highly reliable technology



Waste-to-Energy:

Go for it !



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Thank you very much.

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