



# **Seminar on Thermal Waste Treatment**

**Development of Thermal Waste Treatment Facilities in  
Larger German Cities and  
Possible Application to Hong Kong**

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## **Content of Presentation**

- 1. Introduction of Engineering Group Dr Born – Dr Ermel**
- 2. Development of Thermal Waste Treatment and Measures of Emission Control in Germany**
- 3. Climatic Relevance of Thermal Waste Treatment**
- 4. Example of WTE Plants in Larger German Cities: City of Frankfurt**
- 5. Recommendations for Hong Kong**



# 1

## **Development of Thermal Treatment Facilities in Large Cities of Germany and Possible Application to Hong Kong**

### **Introduction**

***Engineering Group Dr Born – Dr Ermel***



# **Introduction**

## **Engineering Group Dr Born – Dr Ermel**



**Waste-to-Energy Plant  
City of Kiel**



**Sanitary Landfill Hofer**



**Mechanical-Biological  
Treatment Plant  
Asslar**



# 2

**Development of Thermal Treatment Facilities in  
Large Cities of Germany and  
Possible Application to Hong Kong**

**Development of Thermal Waste  
Treatment and Measures of Emission Control  
in Germany**



# Development of Thermal Waste Treatment in Germany

- ❑ First WTE Plant established in Hamburg in 1893
- ❑ Development of WTE Capacity since 1965:
  - 1965: 7 WTE plants with 718,000 tons per year
  - 2007: 75(\*) WTE Plants with 17.8 million tons per year  
(\* including RDF Plants)
  - In future: > 90% of Solid Waste to be treated thermally
- ❑ Continuous development of emission control regulations in Germany and the EU, especially since 1970
- ❑ Major Milestones:
  - Technical Instruction Air (1974/1986) – TA Luft
  - 17th Ordinance to Federal Emission Law (1990/1999/2003) – 17. BImSchV
  - EU-Regulation 2000/76/EG – Adoption of 17. BImSchV





## Development of Measures for Emission Control

Parameter	TA Luft (general demand)	13th BImSchV (for Power Plants > 300 MW)	17. BImSchV (for WTE)	Operational Emission Data of WTE(*)
<b>C<sub>tot</sub></b> (mg/m <sup>3</sup> )	50	---	10 (daily average)	<5
<b>CO</b> (mg/m <sup>3</sup> )	100	200	50 (daily average)	<20
<b>HCl</b> (mg/m <sup>3</sup> )	30	not relevant	10 (daily average)	<5
<b>HF</b> (mg/m <sup>3</sup> )	3	not relevant	1 (daily average)	<0.5
<b>SO<sub>2</sub></b> (mg/m <sup>3</sup> )	350	200	50 (daily average)	<10
<b>NO<sub>x</sub></b> (mg/m <sup>3</sup> )	350	200	200 (daily average)	<100
<b>Dust</b> (mg/m <sup>3</sup> )	20	20	10 (daily average)	<1
<b>PCDD/PCDF</b> (ng TE/m <sup>3</sup> )	0.1		0.1 (mean during sampling)	<0.005

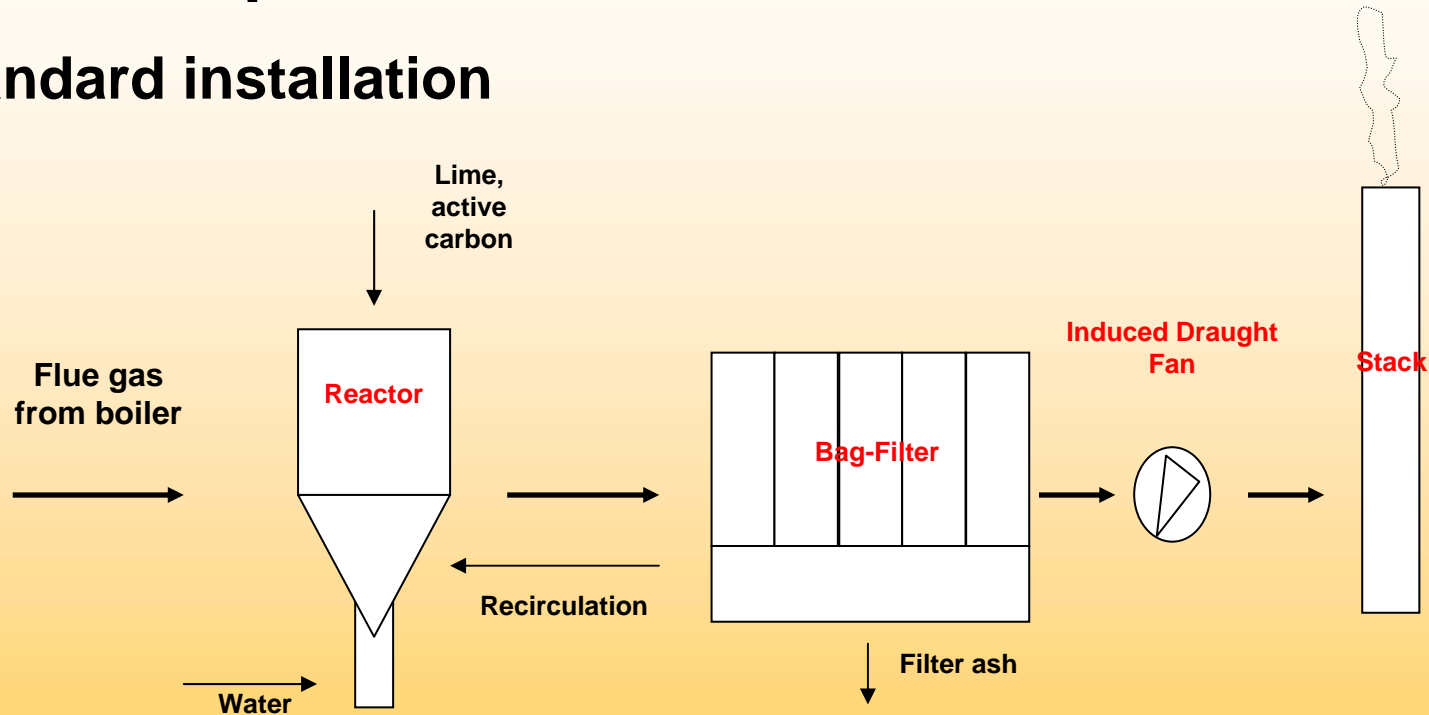
### Comparison of Legal Emission Limits and Operational Data

(\*) average of all existing WTE in Germany



# Options of Flue Gas Treatment

## □ Standard installation

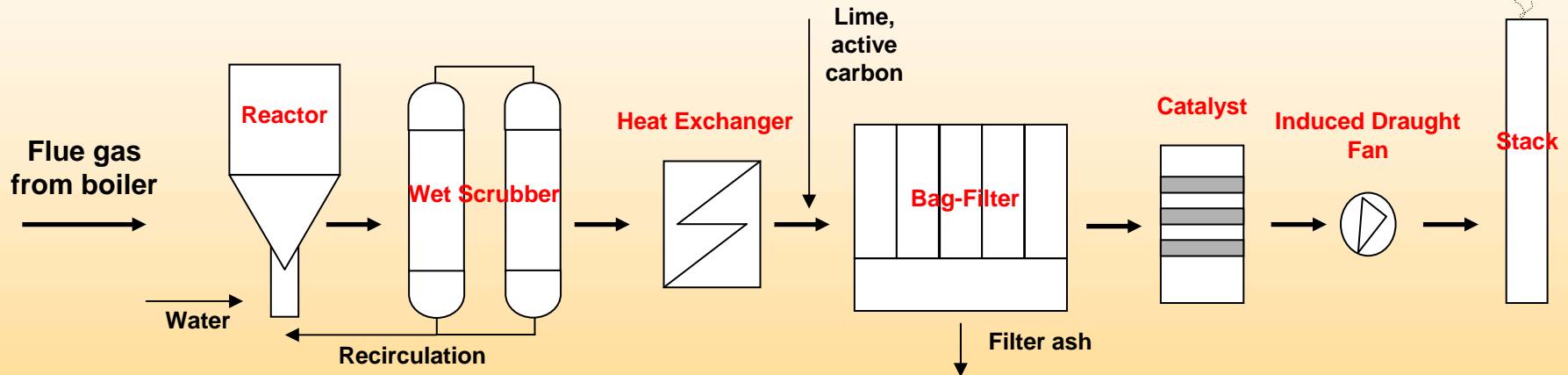


- Emission parameters acc. to actual legal limits
- High operational security
- Low operational costs and investment



# Options of Flue Gas Treatment

## □ Multi-stage installation

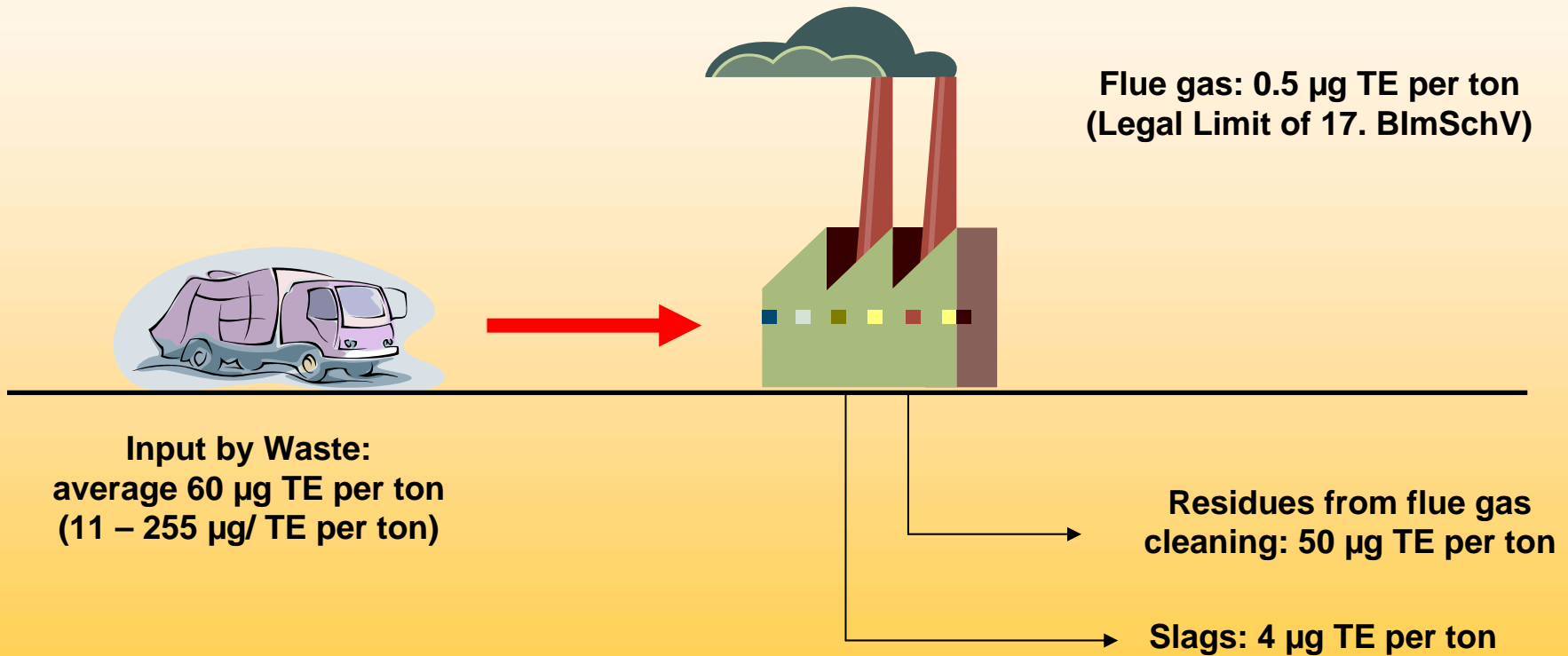


- Emission parameters < 30% below actual legal limits
- High operational efforts
- High operational costs and investment



# Environmental Impact of WTE Emissions

## *Example Dioxin*



**Dioxin balance of a modern WTE Plant**



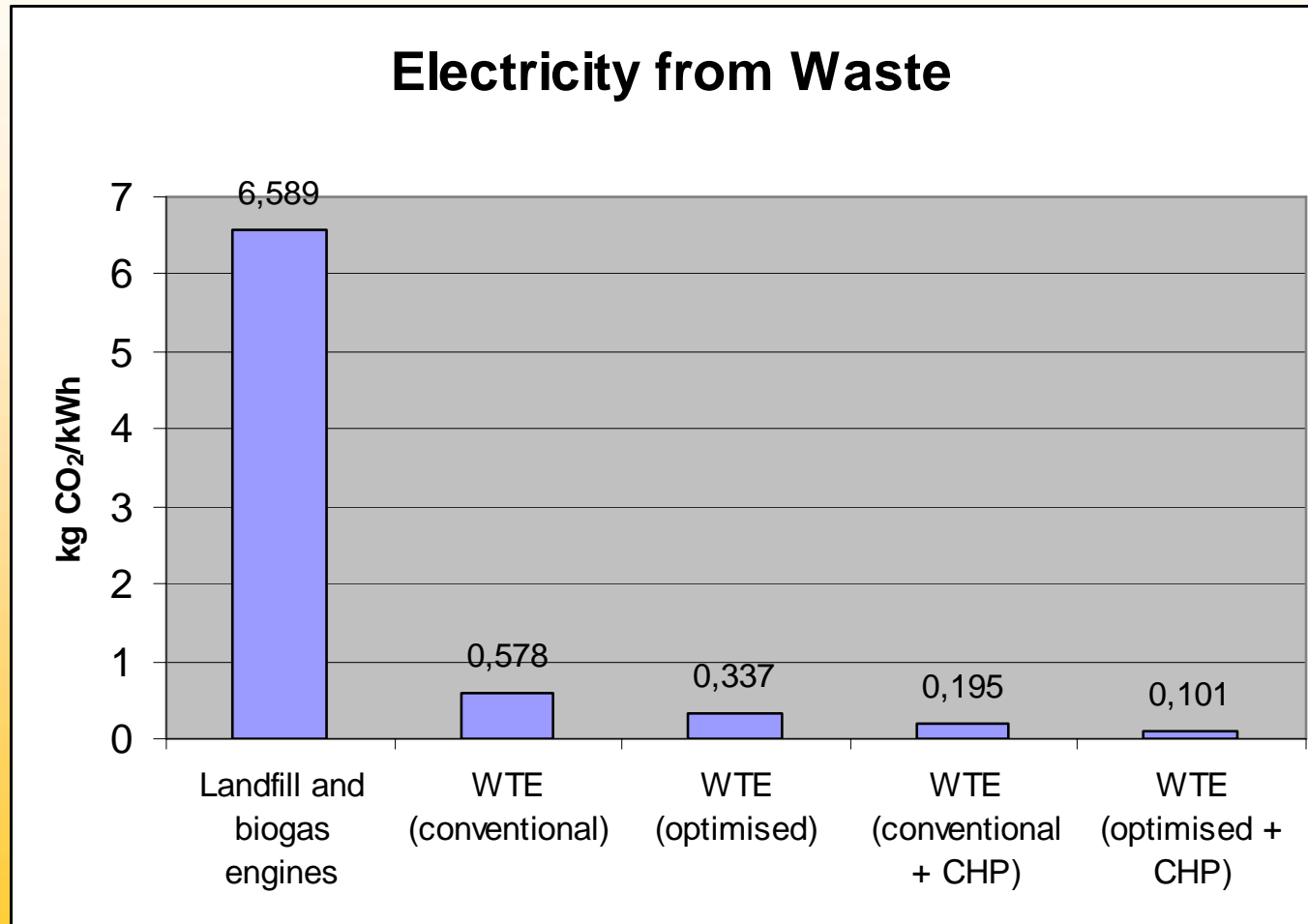
# 3

**Development of Thermal Treatment Facilities in  
Large Cities of Germany and  
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**Climatic Relevance of Thermal Waste Treatment**



# Climatic Relevance of Thermal Waste Treatment

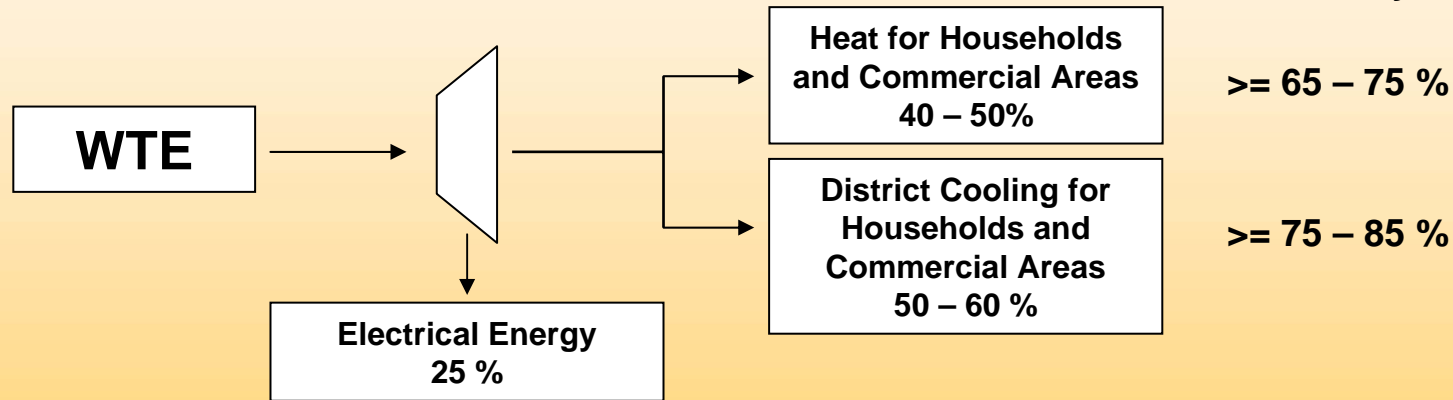


**Comparison of Specific CO<sub>2</sub>-Emissions by Electricity from Waste**

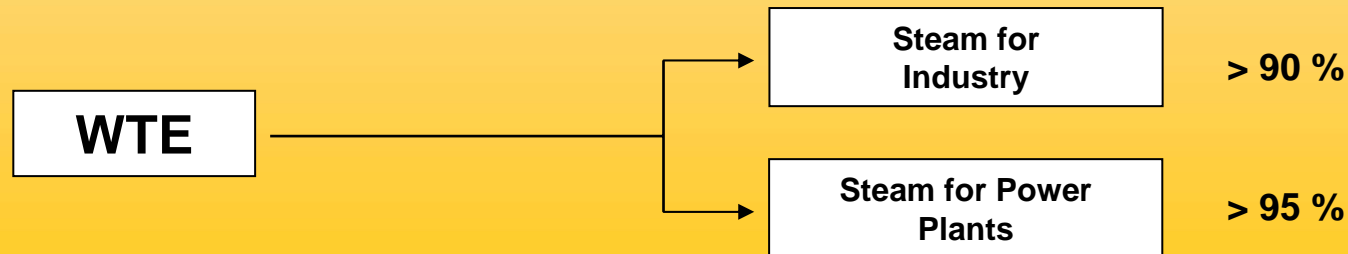


# Introduction: Environmental Impact of WTE Emissions

## □ WTE in combination with residential area



## □ WTE in combination with steam consumers





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**Development of Thermal Treatment Facilities in  
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**Examples of WTE Solutions  
in Lager German Cities**

***WTE Plant in the City of Frankfurt***



## WTE Plant Frankfurt

### Why do we normally find WTE Plants in the City Centres in Germany?

- Location near the gravity centre of waste generation avoids transport traffic which will effect additional air pollution
- Modern WTE Plants with appropriate flue gas cleaning equipment are commonly accepted as necessary infrastructure in Germany and Europe
- City Centres are perfect locations for distribution of district heating and/or process energy for industrial purposes
- More than 30 years of experience with such installations prove no significant impacts both to environment and humans



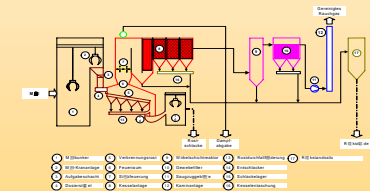
# WTE Plant of the City of Frankfurt

## Scope of Engineering Work:

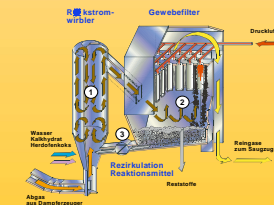
- ❑ Increase of capacity of WTE Plant up to 4 x 20 tons/hour with thermal capacity of 4 x 57 MW (640,000 tons/year)
- ❑ Implementation of incineration and flue gas cleaning technology according to state of technique
- ❑ Connection of WTE and Power Plant to a common facility by making use of any available operational, energetic and economical synergetic effect



WTE Frankfurt



Scheme of WTE plant



Scheme of flue gas cleaning device



# WTE Plant of the City of Frankfurt

## Site situation



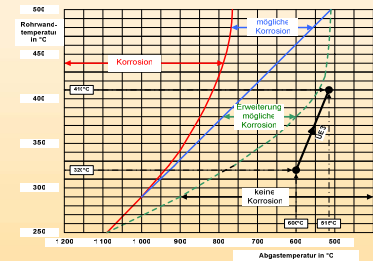


# WTE Plant of the City of Frankfurt

## Optimization of Energy Efficiency:

- ❑ Increase of steam parameters of WTE plant considering critical corrosive conditions (60 bar at 500°C)
- ❑ Implementation of high-capacity turbine inside the Power Plant with high power output (i.e. 55 MW electrical power)
- ❑ Extension of district heating grid by acquisition of additional industrial clients and town districts

Corrosion diagram



Assembly of Turbine





## WTE Plant of the City of Frankfurt

- ❑ Overall energy efficiency of former existing setup:  
  
approx. **37** %
  
- ❑ Overall energy efficiency of re-engineered facilities:  
  
approx. **> 70** %
  
- ❑ Guarantee of recycling plant of WTE Frankfurt with the possibility of flexible response to entire waste market (access to thermal recyclable waste from commercial and industrial sources)



# WTE Plant of the City of Frankfurt



**New Boiler House**



# WTE Plant of the City of Frankfurt



Construction Site



# WTE Plant of the City of Frankfurt



View of WTE Plant Frankfurt



# **WTE Plant of the City of Frankfurt**



**Neighbouring residential area**



## WTE Plant of the City of Frankfurt



Adjacent public infrastructure



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**Development of Thermal Treatment Facilities in  
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**Recommendations for Hong Kong**



## **Recommendations for Hong Kong**

- ❑ WTE site requires suitable connection to traffic infrastructure (e.g. transport by sea cargo)**
  - ❑ Recommended economical capacity of WTE is  $\geq 1,000,000$  tons/year**
  - ❑ Optimized use of energy shall be considered (electrical/heat/cold) efficiency target  $> 70\%$**
  - ❑ Operationable thermal system (proven technique: moving grate)**
  - ❑ Efficient steam parameters ( $<60$  bar,  $450$  deg. C)**
  - ❑ Flue gas cleaning acc. to state of technique (European standard)**
- Compliance with above criteria will enable economical and environmental friendly thermal waste treatment**



**Thank you for your kind attention!**



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