

Für Mensch & Umwelt

Umwelt   
Bundesamt

# German Experiences on Alternative Technologies for the Thermal Treatment of Waste

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## **Development of Alternative Technologies for the Thermal Treatment of Waste**

**During the last 40 years several “new and innovative” technologies for the thermal treatment of waste tried to enter the market.**

**The European market only began to seriously reconsider the technologies during the early 1990’s and this was driven by the political desire to avoid the use of incineration.**

**Most of the processes require extensive pre-treatment of the MSW (Municipal Solid Waste).**

## **Development of Alternative Technologies for the Thermal Treatment of Waste**

**Final Expert Report for the Federal Ministry for the  
Environment, Nature Conservation, Building and Nuclear  
Safety Project,  
Report No. 29217**

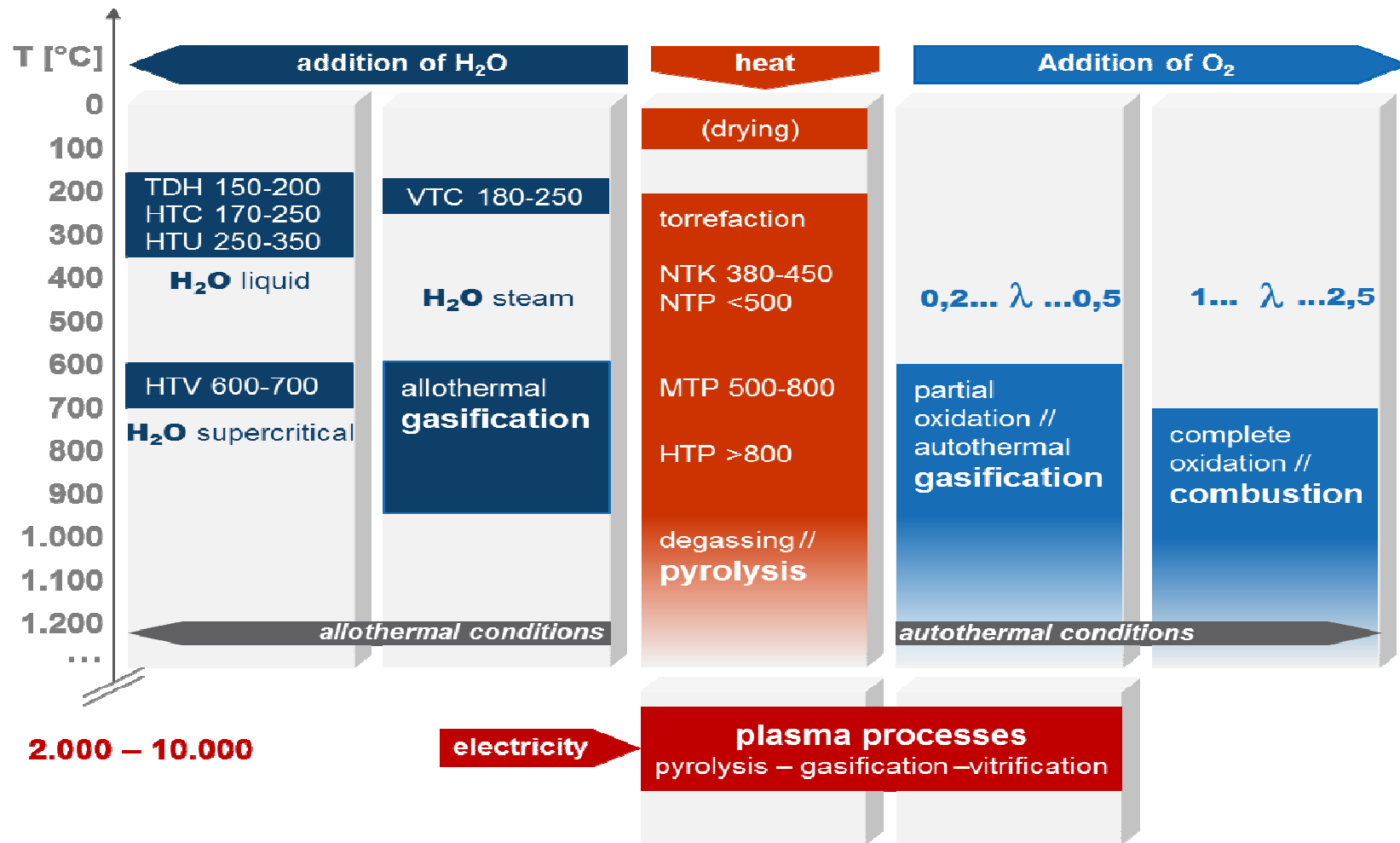
**“Status of Alternative Techniques for Thermal  
Waste Treatment”**

# Development of Alternative Technologies for the Thermal Treatment of Waste

## Project management and project partners

Institution	Editor
<b>Project Management</b>	
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<b>Project Partners</b>	
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Karlsruhe Institute of Technology Institute for Technical Chemistry	Prof. Dr.-Ing. Helmut Seifert Dr. rer. nat. Jürgen Vehlow
TK Verlag Karl Thomé-Kozmiensky	Prof. Dr.-Ing. Karl Thomé-Kozmiensky

# Thermal Treatment Processes



## Criteria for Thermal Treatment Processes

**Based on information at hand, data was structured according to following criteria:**

- State of the art (as in VDI 3460, see next tables)
- Necessary (pre-) treatment effort
- Type and quality of products (eventually as input for follow-up facility)
- Complexity
- Economic efficiency

## Development of Alternative Technologies for the Thermal Treatment of Waste

Development status of thermal waste treatment processes according to [VDI 3460] (simplified).

Devel. status	Status Regarding	Minimum Requirement
1	Plant/Process	bench-scale tests, mass and energy balance of core plant
	Input/Output Materials	descriptive analysis of input and output materials (quality, quantity)
	Market Potential	assessment of market potential of a full-scale plant based on bench-scale test results
	Scale-up	description of risks and opportunities of a scale-up, design of a pilot plant
2	Plant/Process	steady-state operation of a pilot plant, mass and energy balances of a core plant
	Input/Output Materials	analysis of input and output materials (quality, quantity); discussion of opportunities and limitations of input materials
	Market Potential	prediction of market potential of a full-scale plant
	Scale-up	description of technical conditions for a scale-up, further unit operations needed for material feeding and discharge, design pilot plant
	Operation	assessment of potential operating problems (corrosion, erosion, scaling...)

## Development of Alternative Technologies for the Thermal Treatment of Waste

Development status of thermal waste treatment processes according to [VDI 3460] (simplified).

3	Plant/Process	steady-state operation of a pilot plant over a prolonged period, measurement of emissions
	Input/Output Materials	testing of the process-specific products concerning their environmental relevance and utilization options
	Market Potential	description of the market potential of a full-scale plant
	Scale-up	technical and economic interpretation of measurement and analysis results related to a full-scale plant, size of equipment, materials, expected construction and operating costs of a full-scale plant, costs per Mg of waste
	Operation	assessment of the expected run time, plant availability and service life a planned full-scale plant

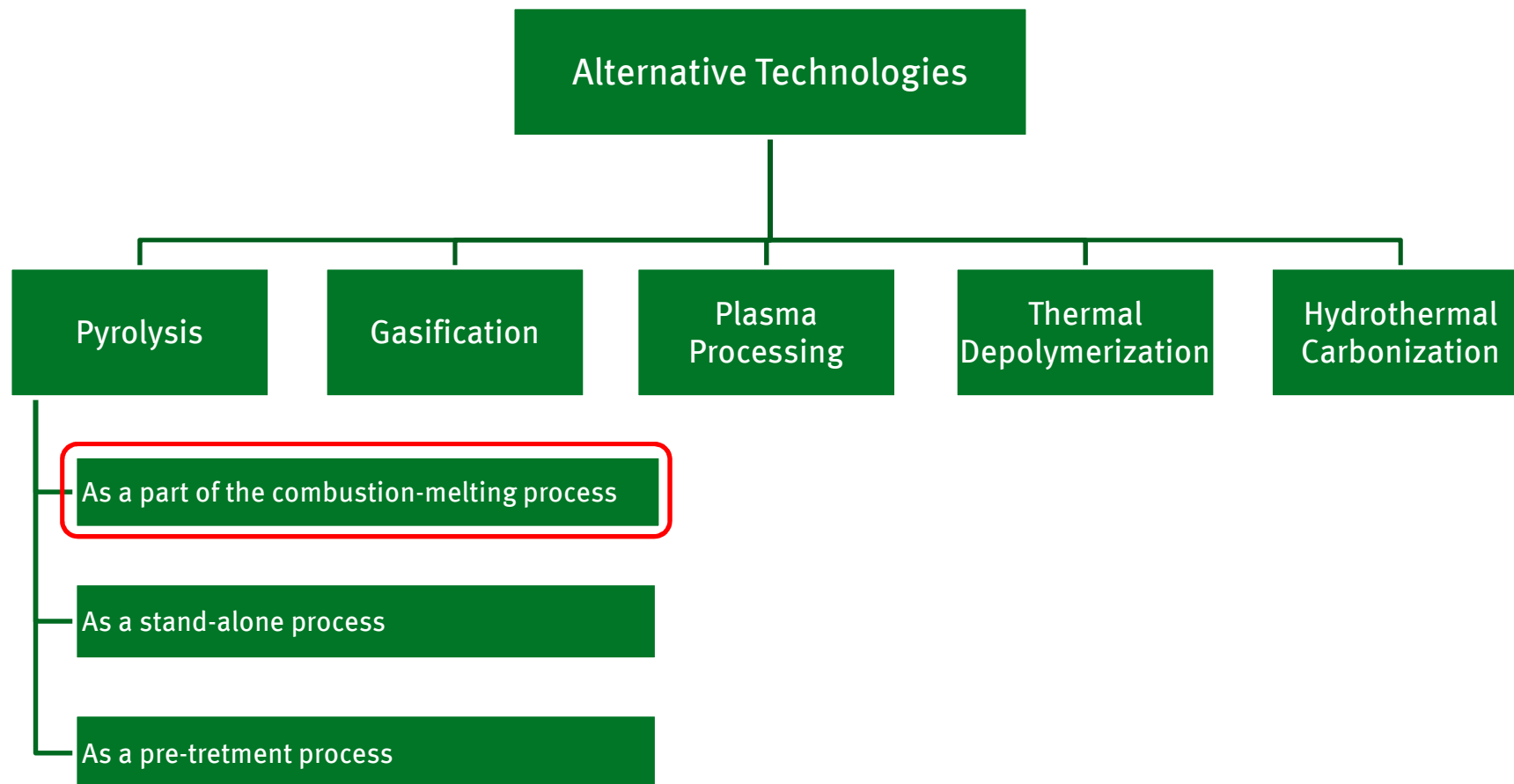


## Development of Alternative Technologies for the Thermal Treatment of Waste

Development status of thermal waste treatment processes according to [VDI 3460] (simplified).

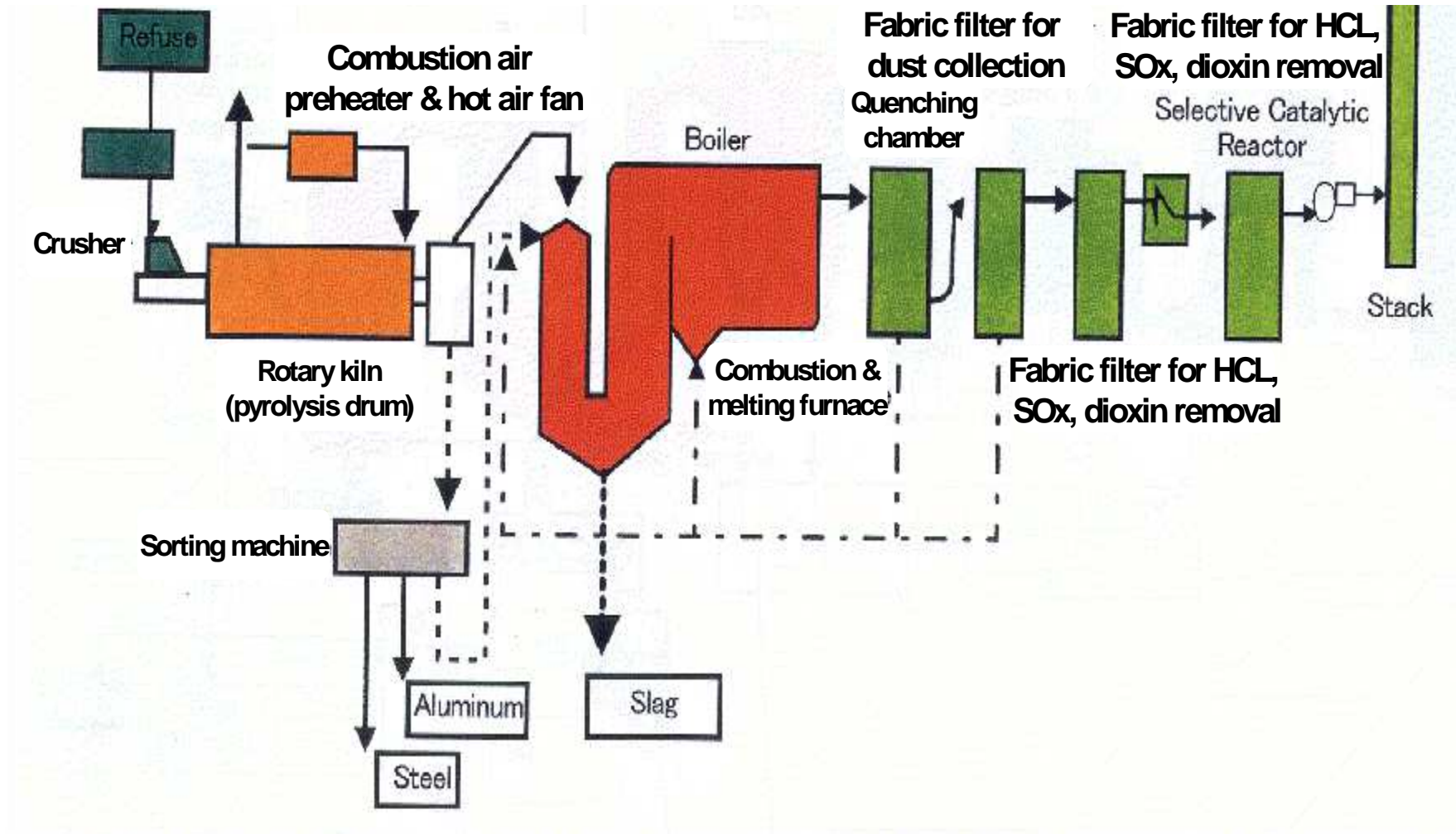
4	Plant/Process	normal operation of full-scale plant over a period of one to two years, confirmation of mass and energy balances, emission values
	Input/Output Materials	demonstration of the suitability of the plant for then planned input materials, marketing potential of typical products generated by the process
	Market Potential	validation of capital and operating costs (business plan)
	Operation	demonstration of availability and runtime
5	Plant/Process	normal operation of full-scale plant over several years, assessment of environmental relevance of the process and plant
	Input/Output Materials	demonstration of disposal of input materials, demonstration of the marketing of process-specific products
	Market Potential	traceable description of capital and operating costs over several years
	Operation	optimization efficiency, availability, runtime

## Alternative Technologies for the Thermal Treatment of Waste



# Pyrolysis as a Part of the Combustion-melting Process

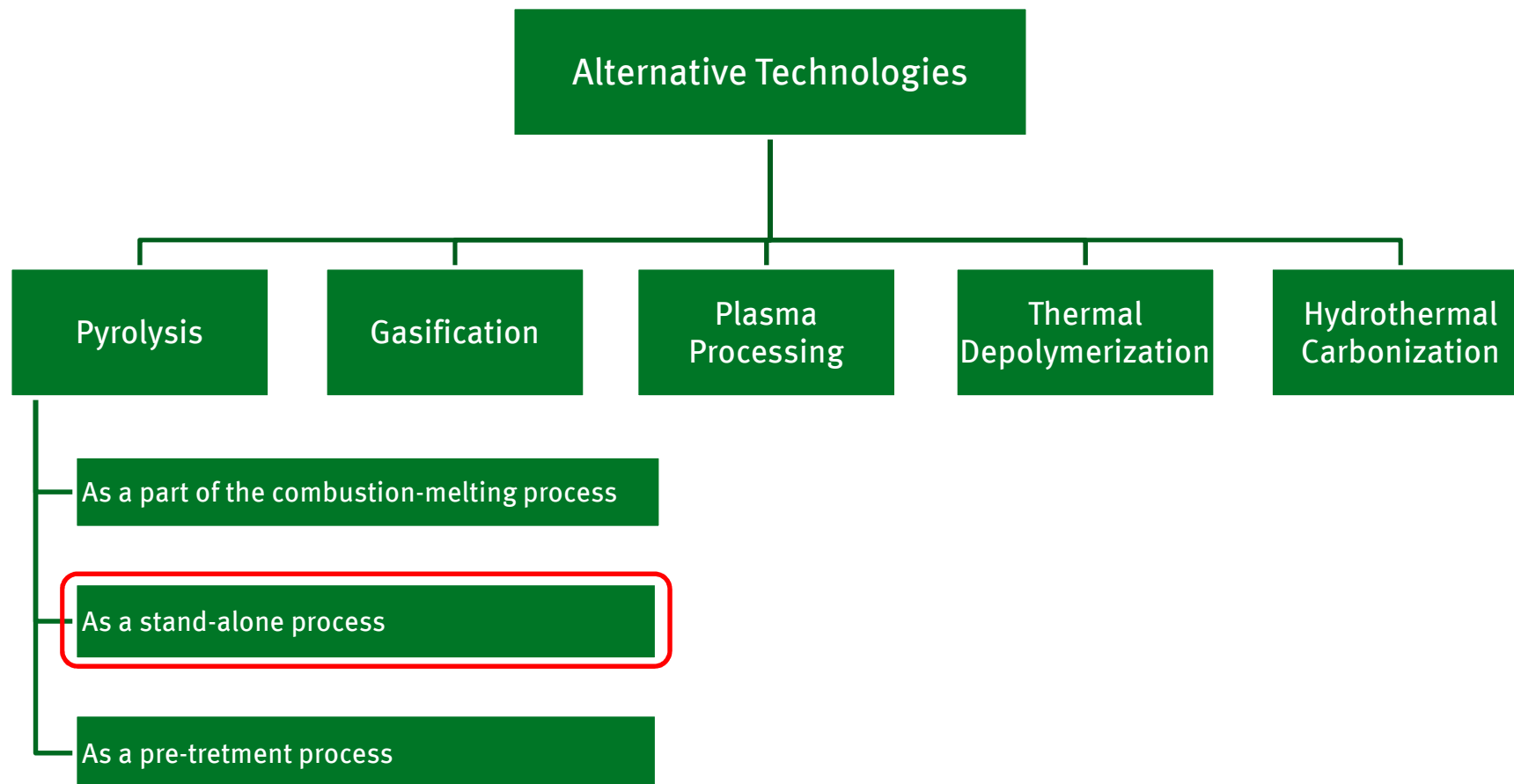
Siemens Schwel-Brenn-Prozess (Fürth)



## Pyrolysis as a Part of the Combustion-melting Process

- **KWU Siemens Schwel-Brenn:**  
150,000 Mg/a, closed down after accident
- **Kiener Pyrolyse:**  
closed down at 2002
- **PKA-Process:**  
two-stage process: pyrolysis and gas-cracking, closed down at 2007
- **DAL (Deutsche Anlagen Leasing):**  
pilot plant, process not realised in industrial scale

## Alternative Technologies for the Thermal Treatment of Waste



## Pyrolysis as a Stand-alone Process

Waste Pyrolysis Plant, Burgau

**Input:** household waste, bulky waste, sewage sludge



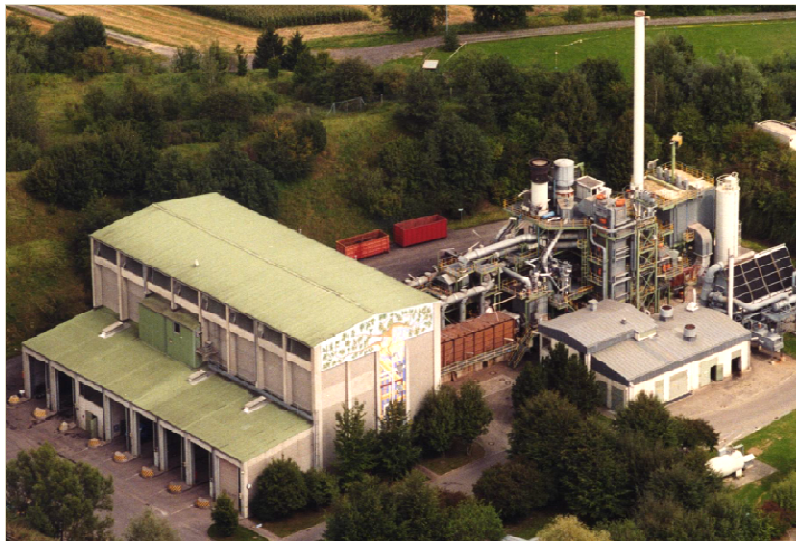
**Characteristics:** co- treatment of sewage sludge contaminated with chrome

→ low process temperature/ lack of oxygen avoid  
formation of chrome IV and release of heavy metals

## Pyrolysis as a Stand-alone Process

Waste Pyrolysis Plant, Burgau

**Plant in operation:** 1984 - present



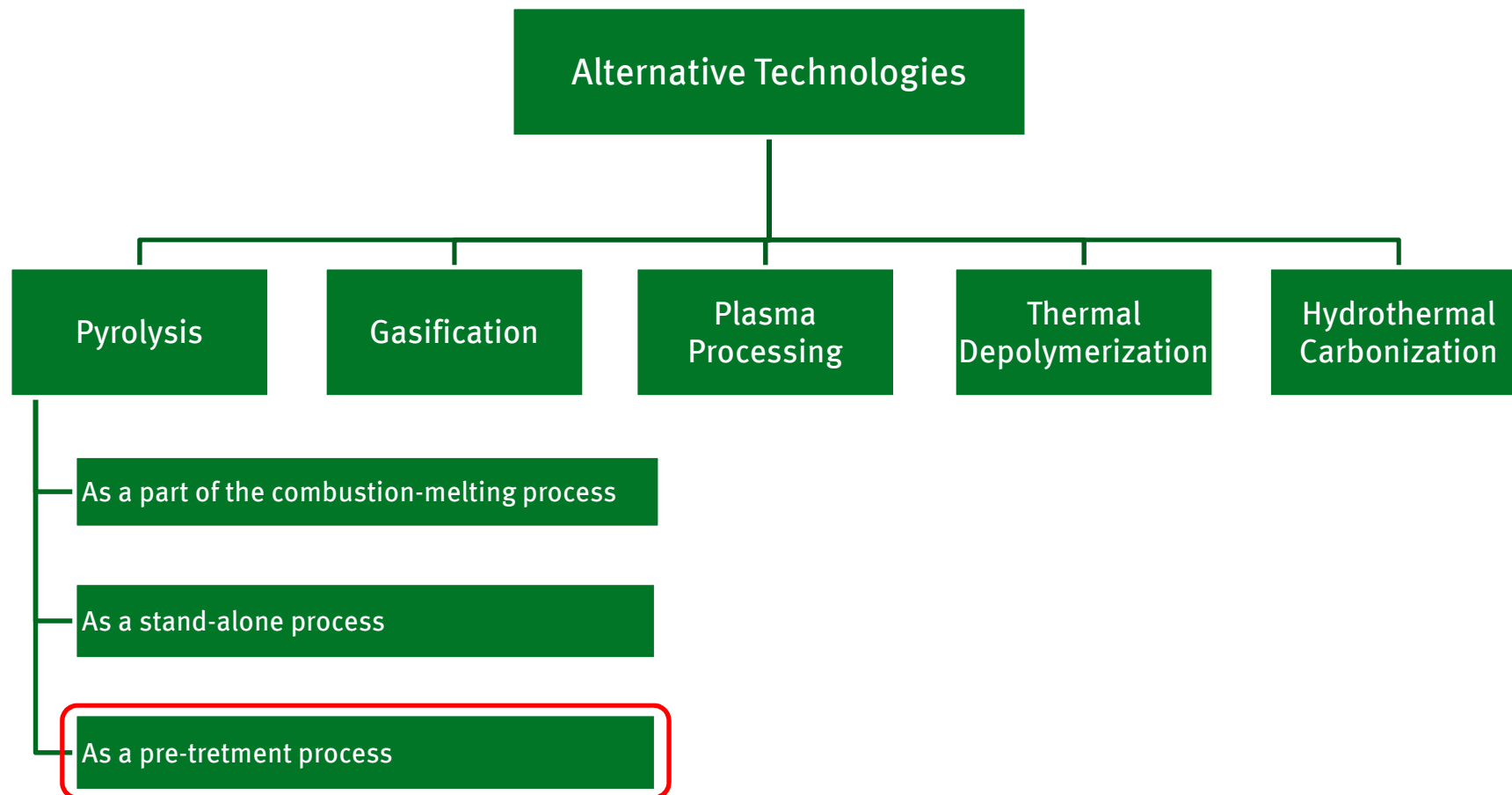
DS  
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**Capacity:** 2 x 3 Mg/h

**Configuration:** 1 X 2.2 MW CHP

**Process:** pre-shredding, pyrolysis at 470 °C – 500 °C, pyrolysis-gas combustion at 1,250° C

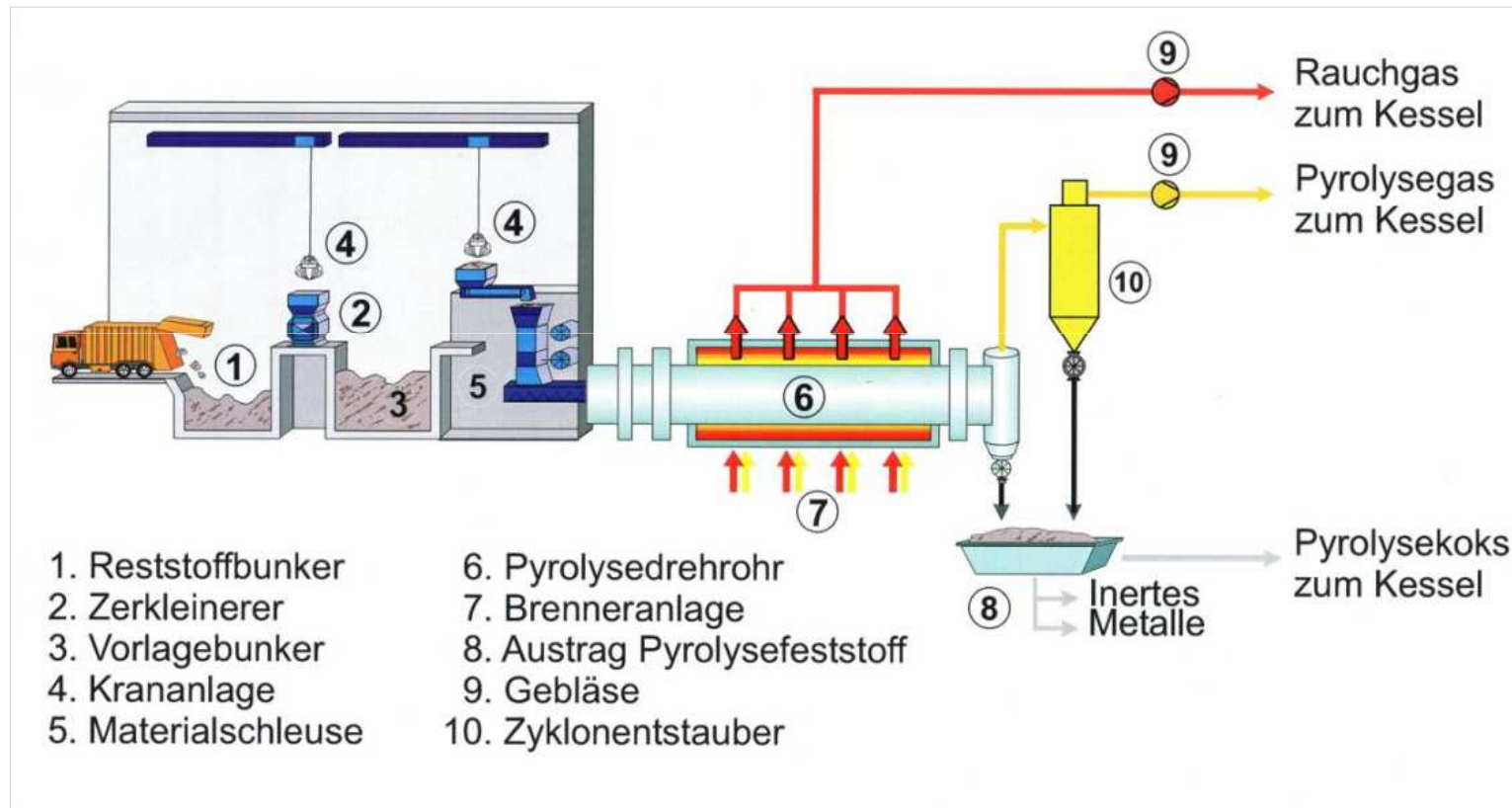
## Alternative Technologies for the Thermal Treatment of Waste





# Pyrolysis as a Pre-treatment Process

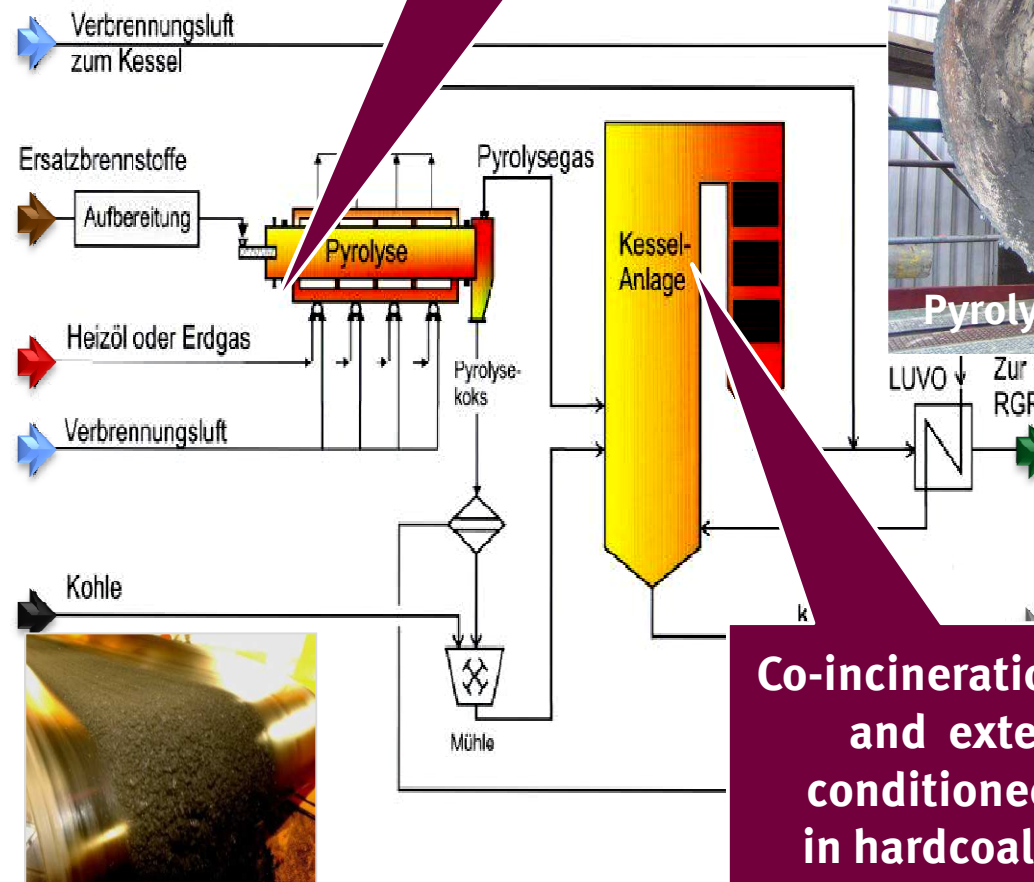
## ConTherm-Process



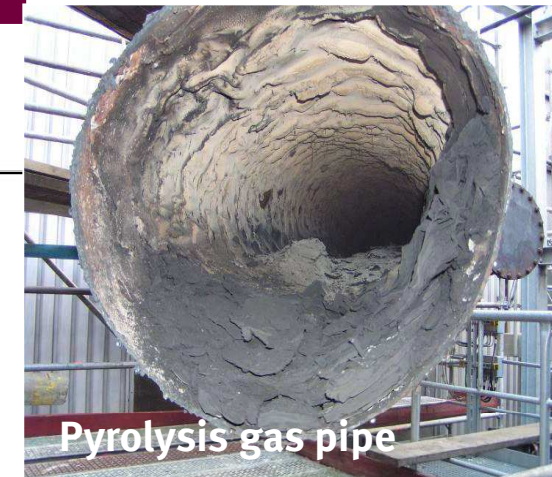
# Pyrolysis as a Pre-treatment Process

DS **5**

## Example: ConTherm



Pyrolysis drum (500 °C)



Co-incineration of gas and external conditioned coke in hardcoal boiler



## Pyrolysis as a Pre-treatment Process

ConTherm-Process in RWE power plant Hamm

**Input:** pre-processed high calorific waste

**Process:** adapted to the waste pyrolysis plan at Burgau, start up in 2001

**Pyrolysis only:** thermal use of the synthesis gas in a coal-fired powerplant

**Capacity:** 100,000 Mg/a

**Thermal input:** 75 MW (waste ~ 90 %, gas ~ 10 %)

**Shutdown** of the plant in 2009  
after a damage for economic  
reasons



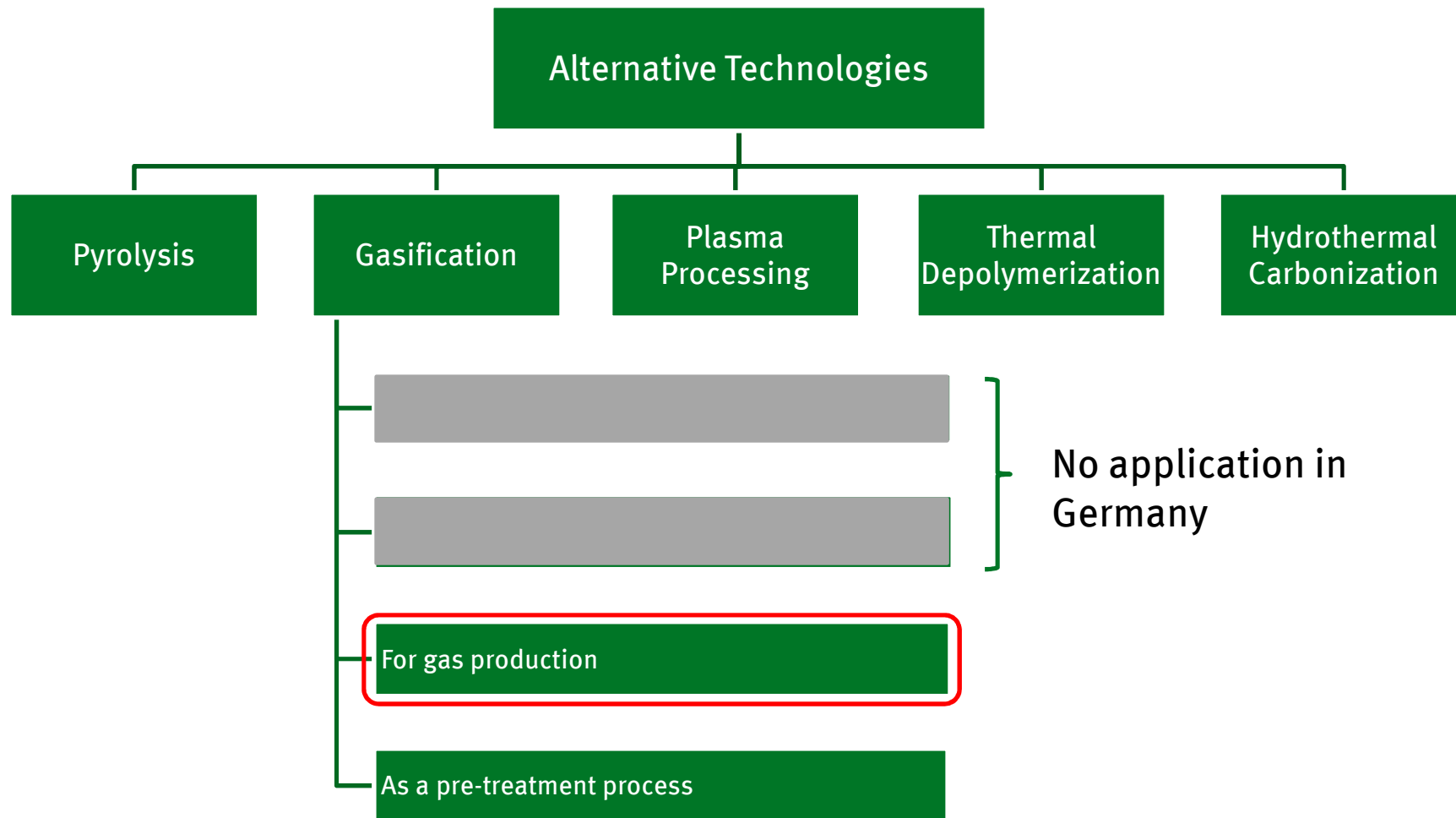
## Pyrolysis as a Pre-treatment Process

ConTherm-Process in RWE power plant Hamm



Picture:<http://www.wa.de/nachrichten/hamm/stadt-hamm/contherm-anlage-hamm-wird-nicht-weiter-betrieben-667645.html>

# Alternative Technologies for the Thermal Treatment of Waste



## Gasification for Gas Production

### SVZ Fixed Bed Gasification

**Input:** pre-processed industrial and municipal waste, tar and oil

.....> agglomeration of waste to pellets, thermal use in combination with coal - (ratio 4:1)



**Process:** conversion of the syngas in methanol and energy in BtL-Process

**Shutdown:** in 2007 as a consequence of economic problems

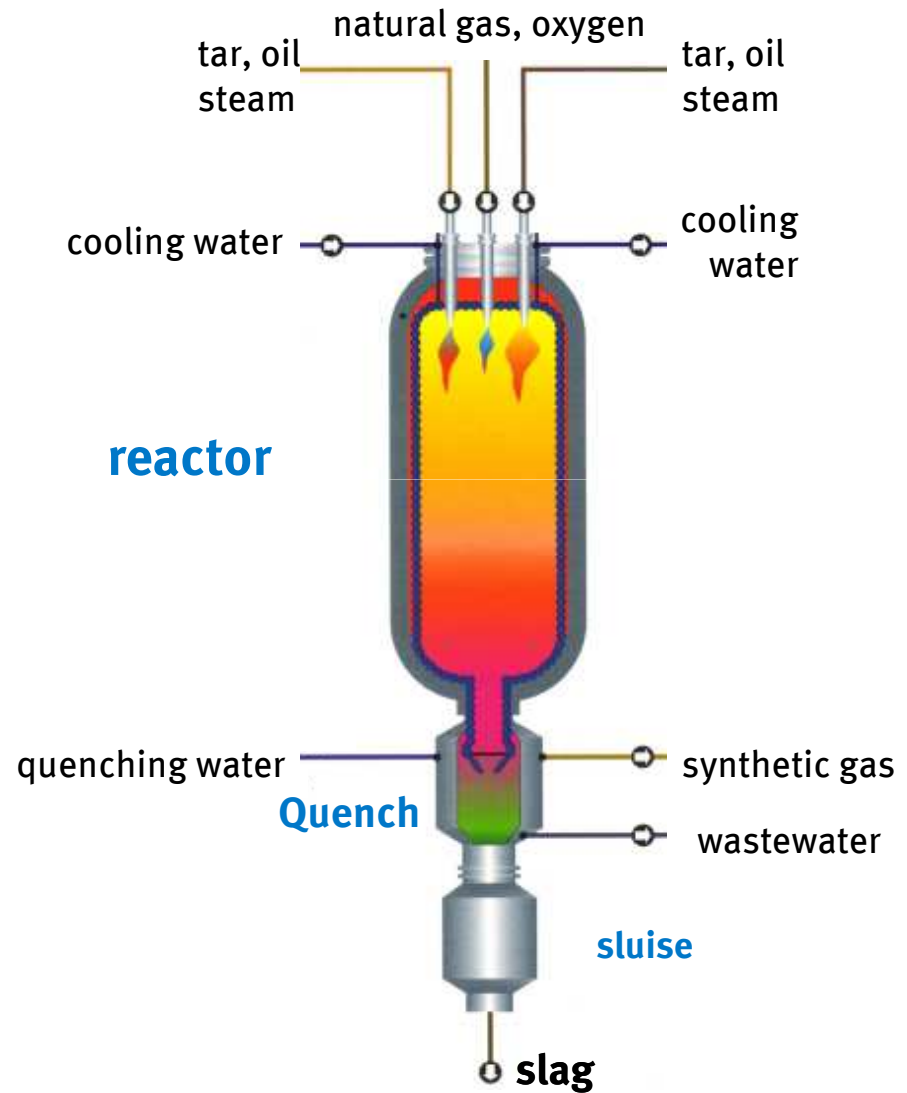
## Gasification for Gas Production

SVZ fixed bed gasification



# Gasification for Gas Production

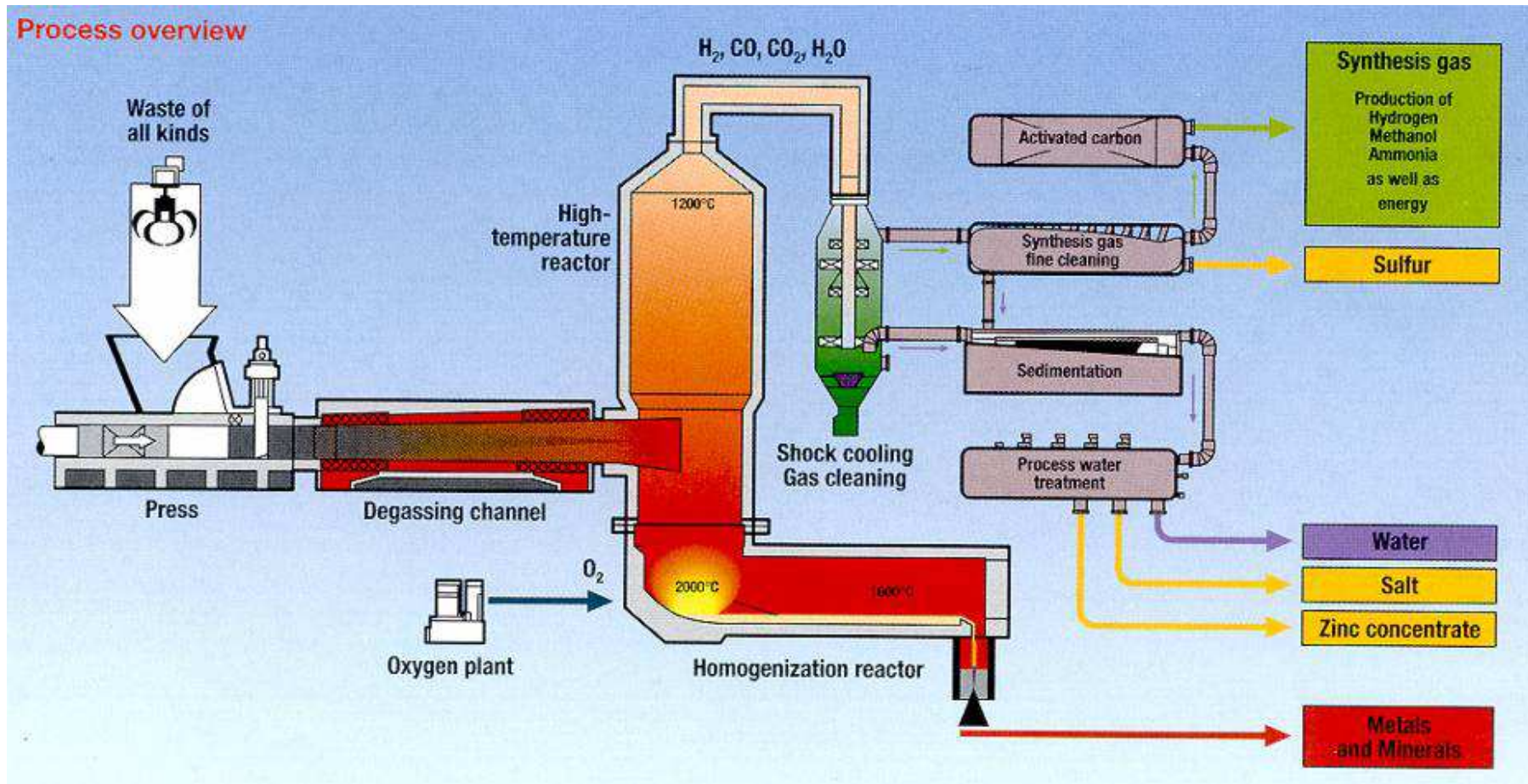
SVZ entrained flow gasifier





# Gasification for Gas Production

## ThermoselectProcess



## Gasification for Gas Production

Thermoselect Process - EnBW Karlsruhe

**Input:** mixed municipal waste

**Capacity:** 225,000 Mg/a

### Operation:

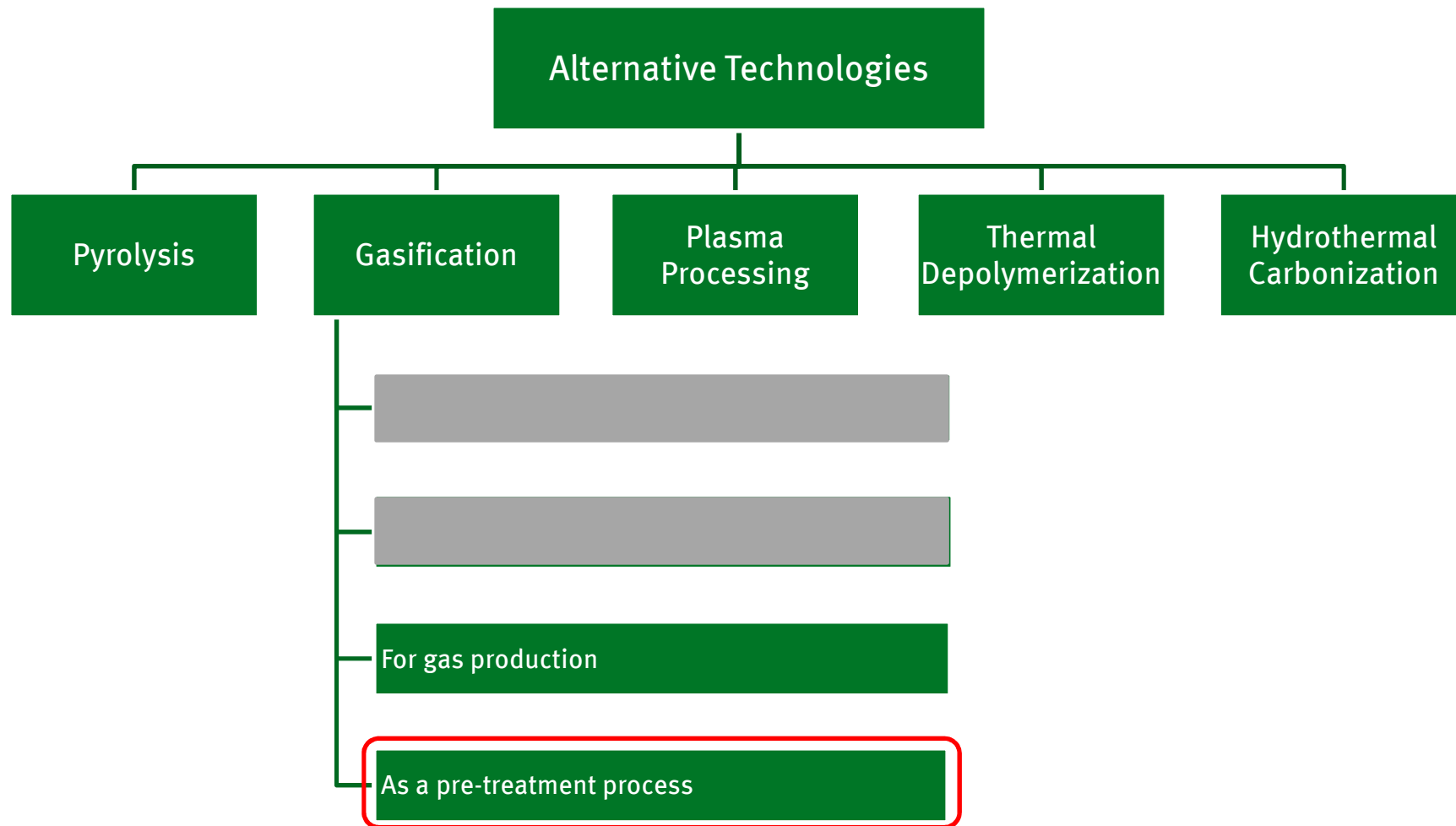
start-up in 1999

steady operation not realized for  
longer periods

shutdown in 2004

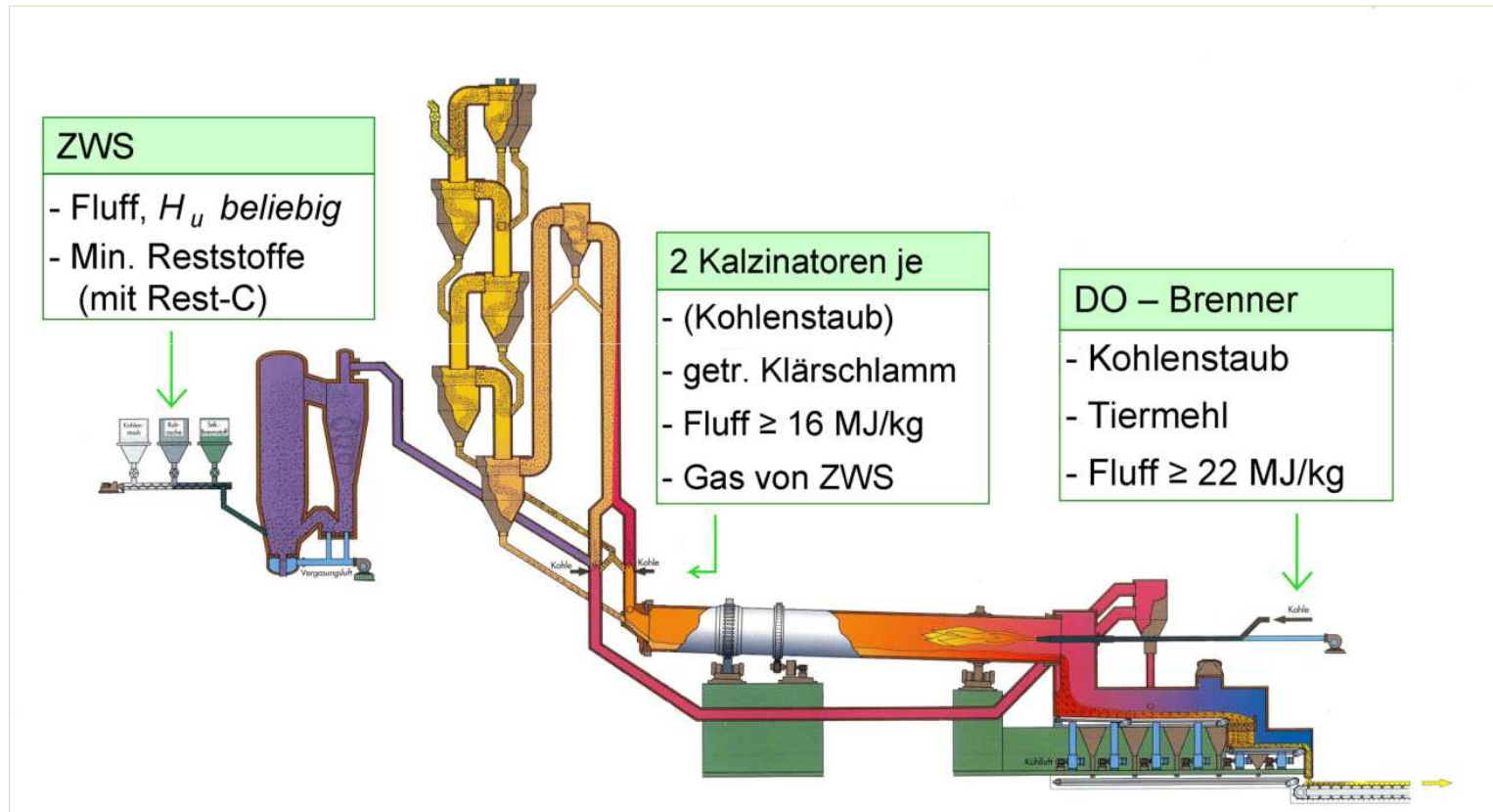


# Alternative Technologies for the Thermal Treatment of Waste



# Gasification as a Pre-treatment Process

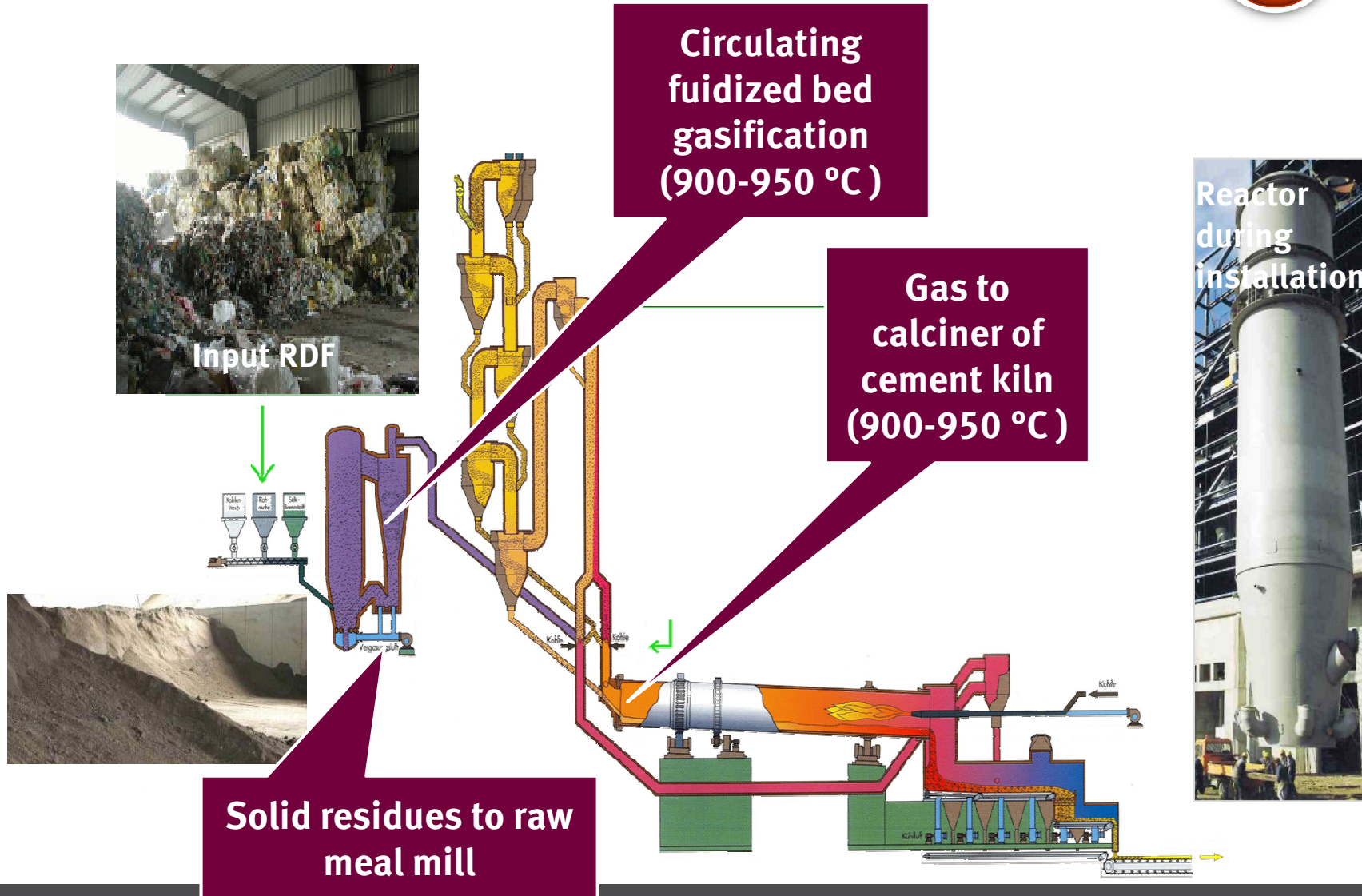
## Envirotherm – ZWS Rüdersdorf



# Gasification as a Pre-treatment Process

## Example: Envirotherm – Rüdersdorf

DS **5**



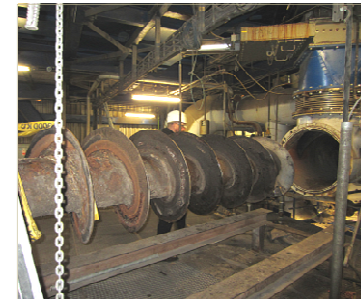
## Gasification as a Pre-treatment Process

Envirotherm – ZWS Rüdersdorf

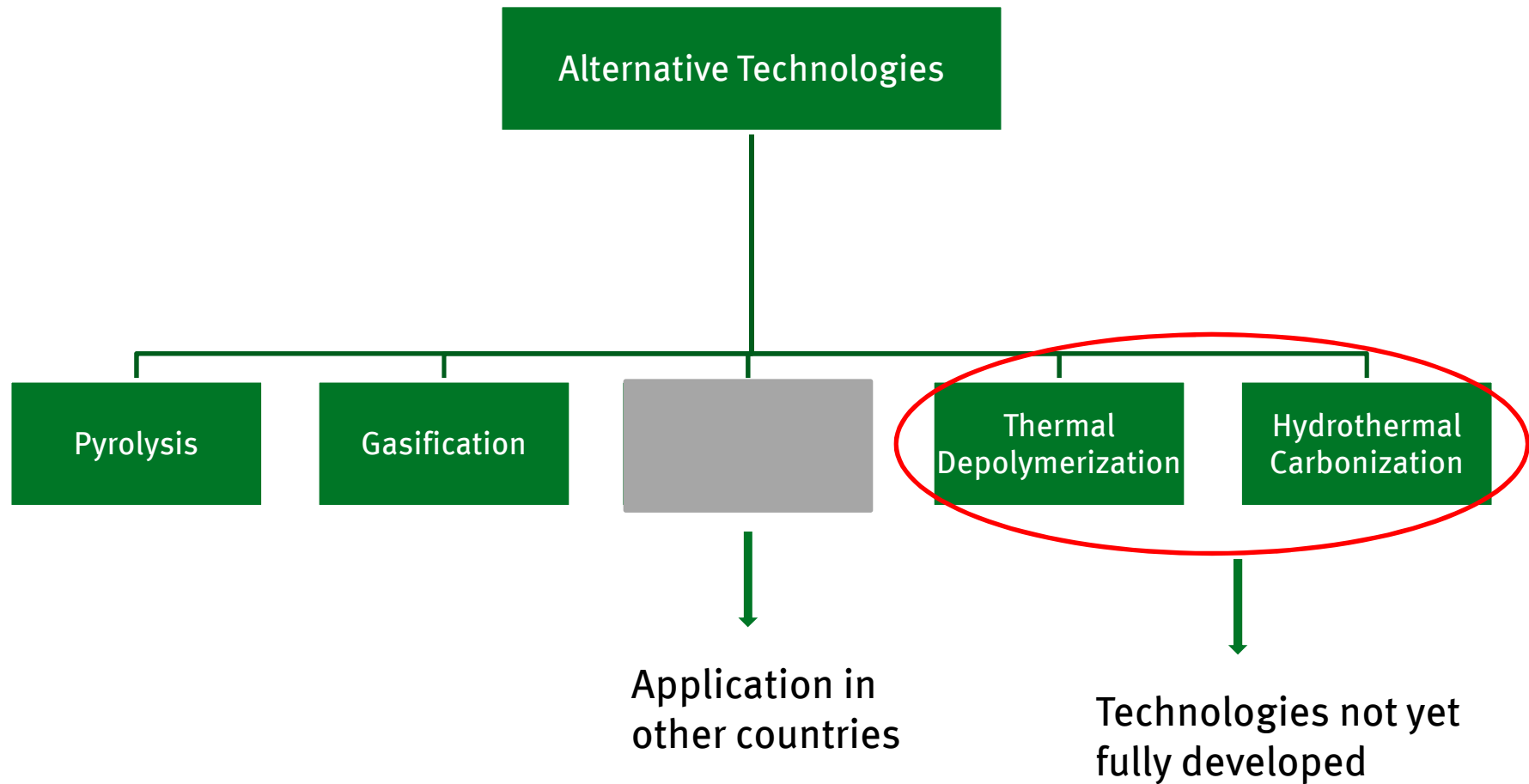
**Input:** mixed municipal waste

**Capacity:** 250,000 Mg/a

**Operation:**  
1996 - present



# Alternative Technologies for the Thermal Treatment of Waste



## Alternative Technologies for the Thermal Treatment of Waste

Main targets for future waste treatment processes

- ✓ Destroy toxic organic components in the waste
- ✓ Reduce volume and amount of the waste
- ✓ Avoid emissions to air, water and soil
- ✓ Produce reusable and recyclable fractions
- ✓ Avoid landfill
- ✓ Produce heat and electrical power or a secondary fuel



**Thank you for your  
attention!**

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