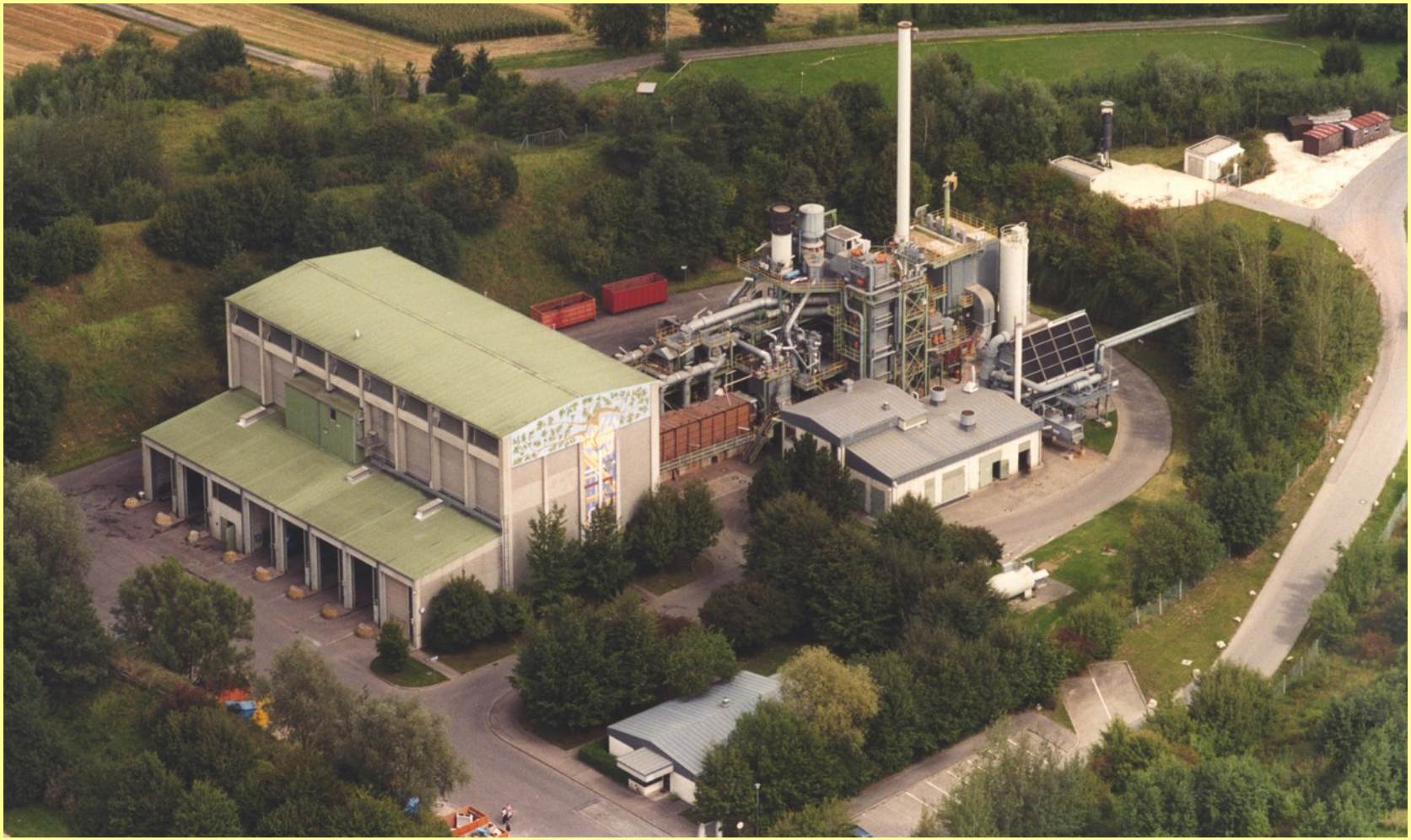
An interdisciplinary waste management concept!

T-Rec

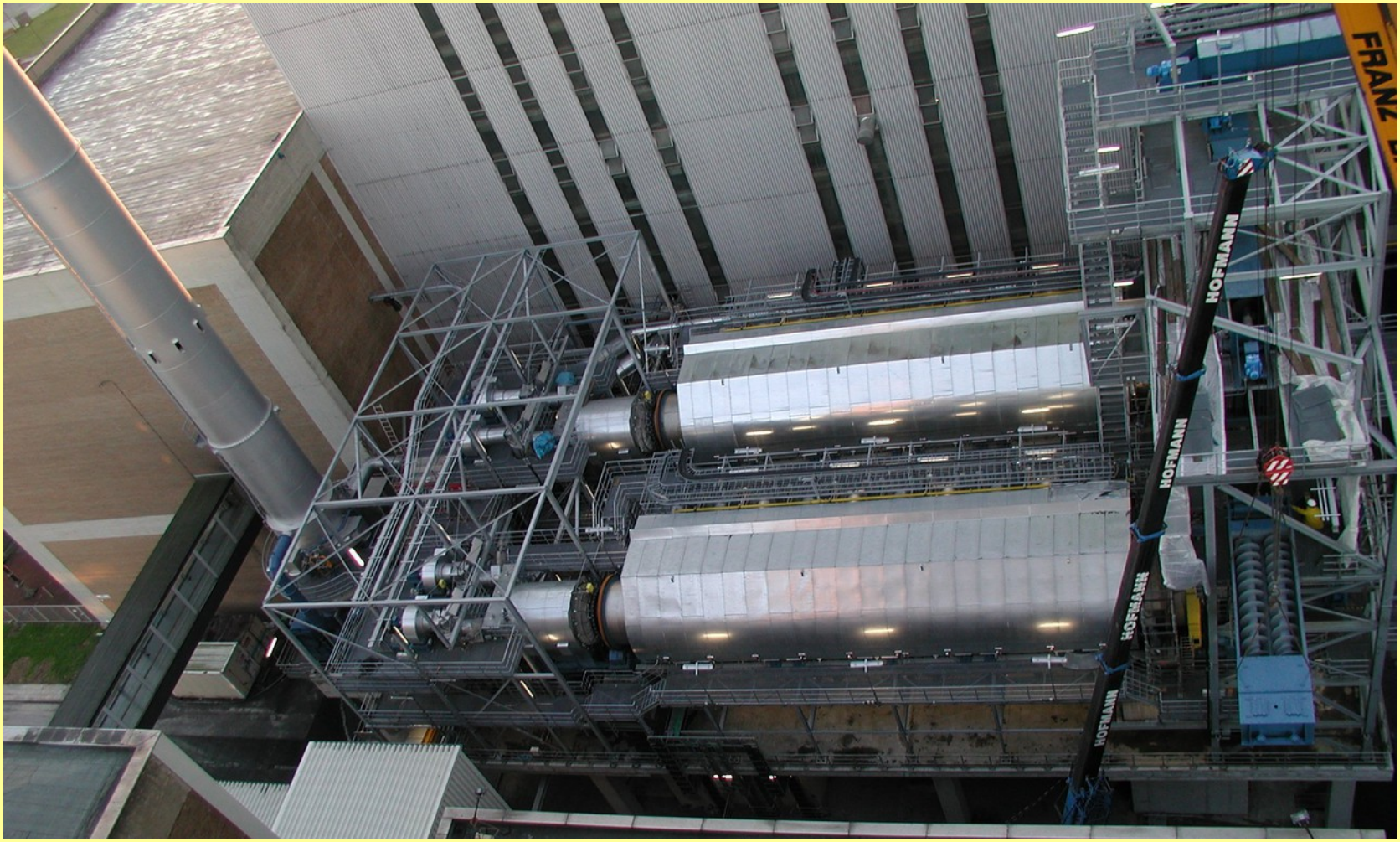
Complete plant “MPA Burgau“ Germany

plant capacity 30,000 to/a bulky waste
operating since 1982



pre-plant for coal-incinerating power plant „Hamm“ Germany

plant capacity 100,000 to/a pre-sorted domestic waste
operating from 2001 - 2009



Complete plant „Limassol“, Cyprus

plant capacity 6,000 to/a granulated scrap tires
operating since 2009

Conventional incineration vs. T-Rec

Conventional incineration calculation:

100,000 t/a 40% water content
7500 operating hours per year
→ 13.3 t/h

Heating value 10.8 MJ/kg = 3 kWh/kg

→ Input energy 39,900 kW
→ Input water 5,320 kg

water evaporation 795 kWh/t
→ energy reduction 4,229 kW

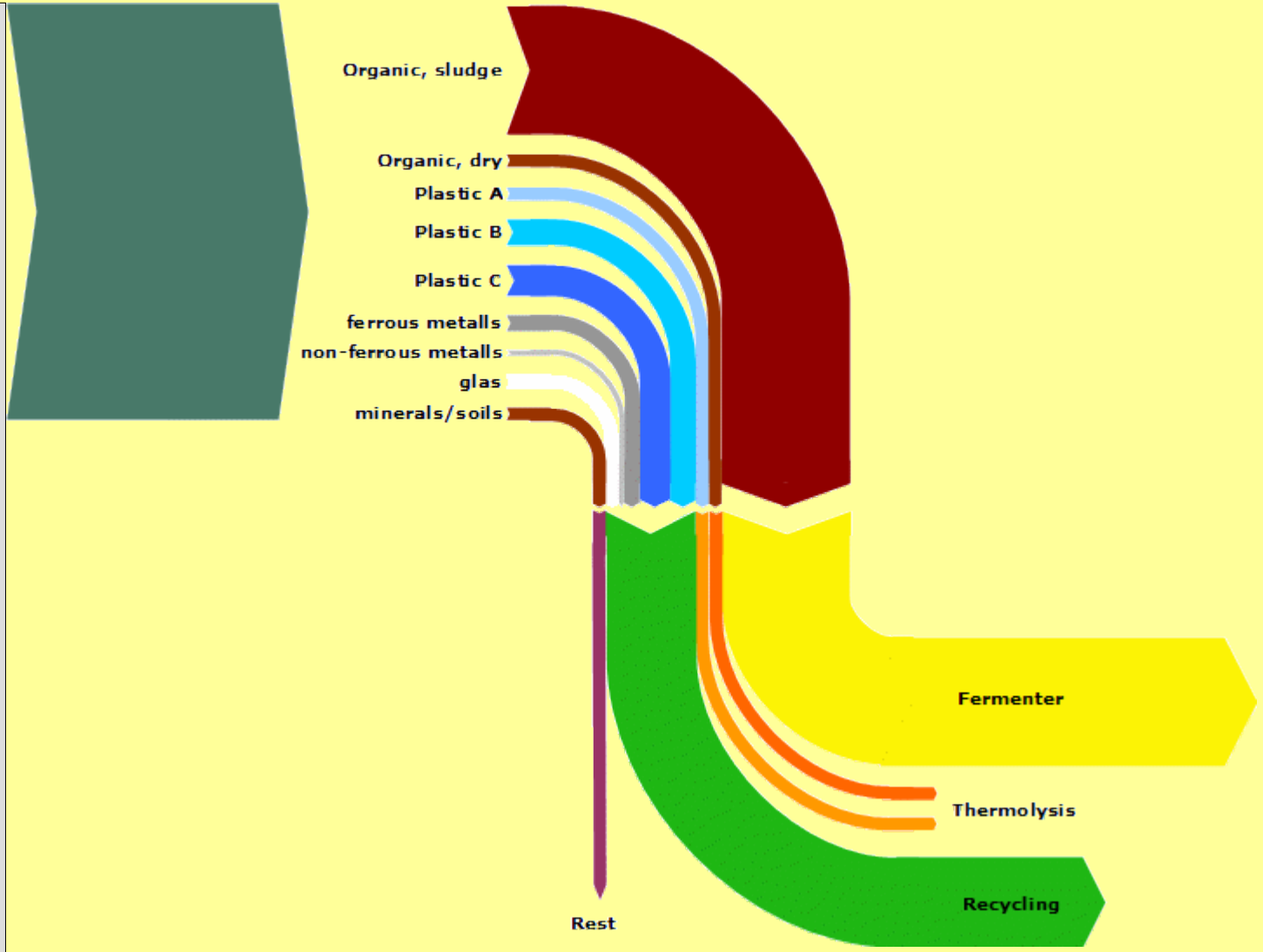
→ usable boiler energy 35,671 kW

Steam circuit efficiency 20%
→ electric power production 7,134 kW

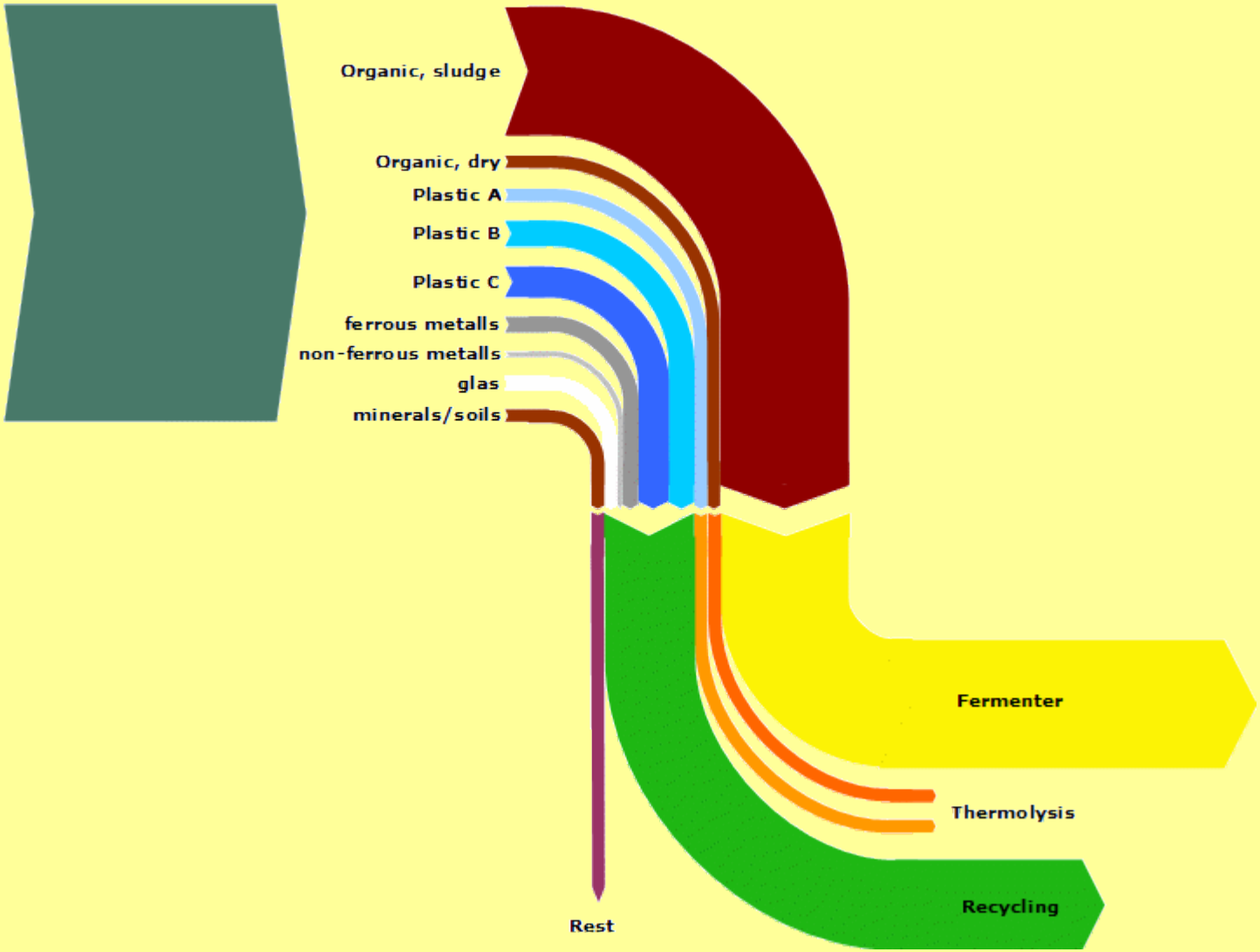
Electric benefit (Germany) 36 €/Mwh
→ 256,82 €/h
→ **1.9 million €/a**

Invest appr. 120 million €
→ **capital cost appr. 19 million €/a**

+ workers
+ energy
+ operating costs



Conventional incineration vs. T-Rec



T-Rec Calculation:

100,000 t/a 40% water content
7,500 operating hours per year
→ 13.3 t/h

Wet organic material
→ 8 t/h
Electric power production

Recycling

glas
→ 500 kg/h

Ferrous metal (220 €/t)
→ 1,000 kg/h
→ 220 €/h

NF metal (2,000 €/t)
→ 500 kg/h
→ 1,000 €/h

PET (600 €/t)
→ 1,000 kg/h
→ 600 €/h

Plastic (300 €/t)
→ 2,000 kg/h
→ 600 €/h

Recycling total
→ **2,420 €/h**
→ **18.15 million €/a**

for thermolysis
→ 3 t/h

Invest appr. 50 million. €
→ **capital cost appr. 7.5 million €/a**

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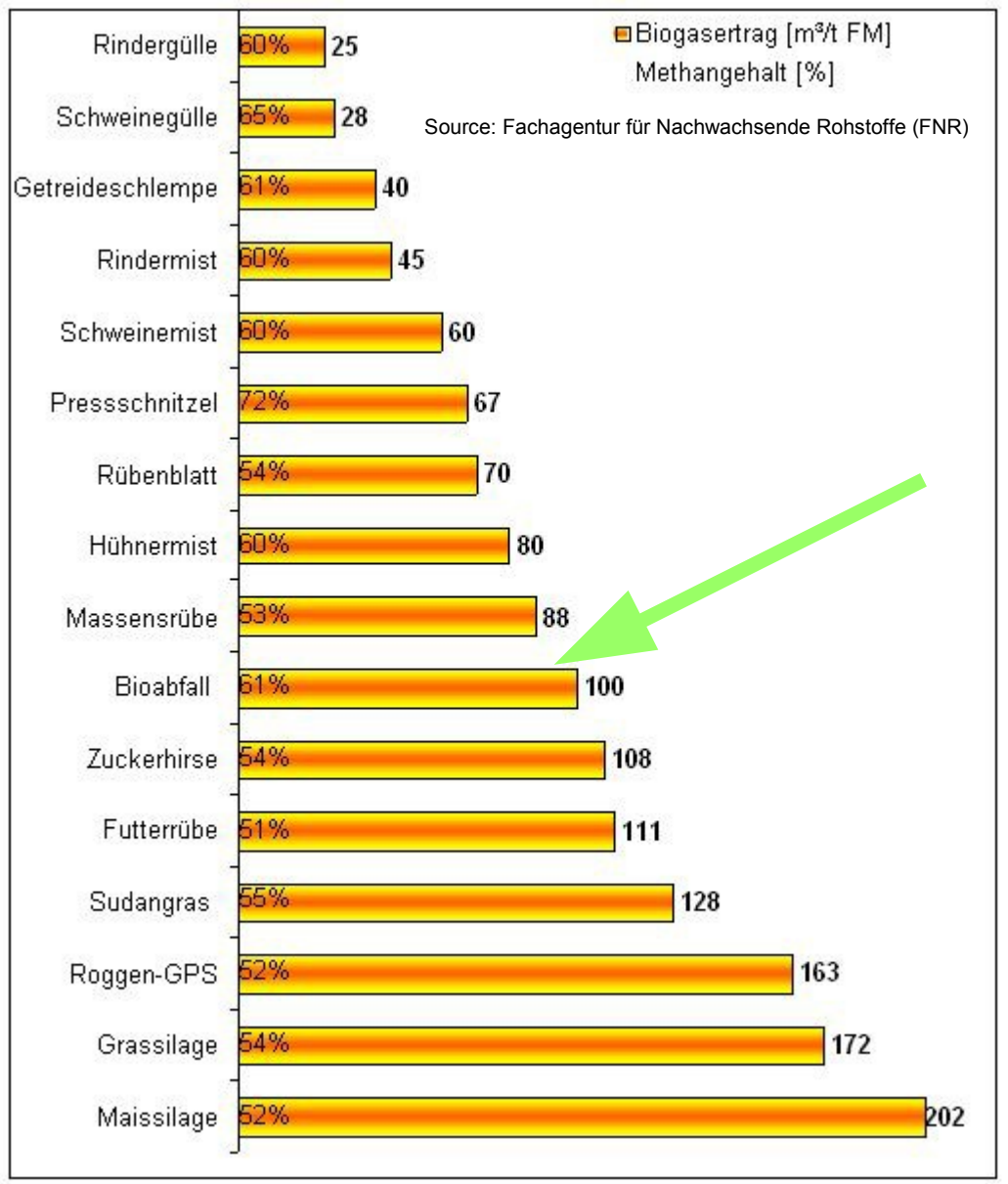
Bio gas production from wet fraction



wet biomass
60.000 t/a

wet biomass
8 t/h

biogas
100 m³/t
→ 800 Nm³/h

methane
61 %
→ 488 Nm³/h
→ 4.3 MW

electric power production
42 %
→ 1,800 kW

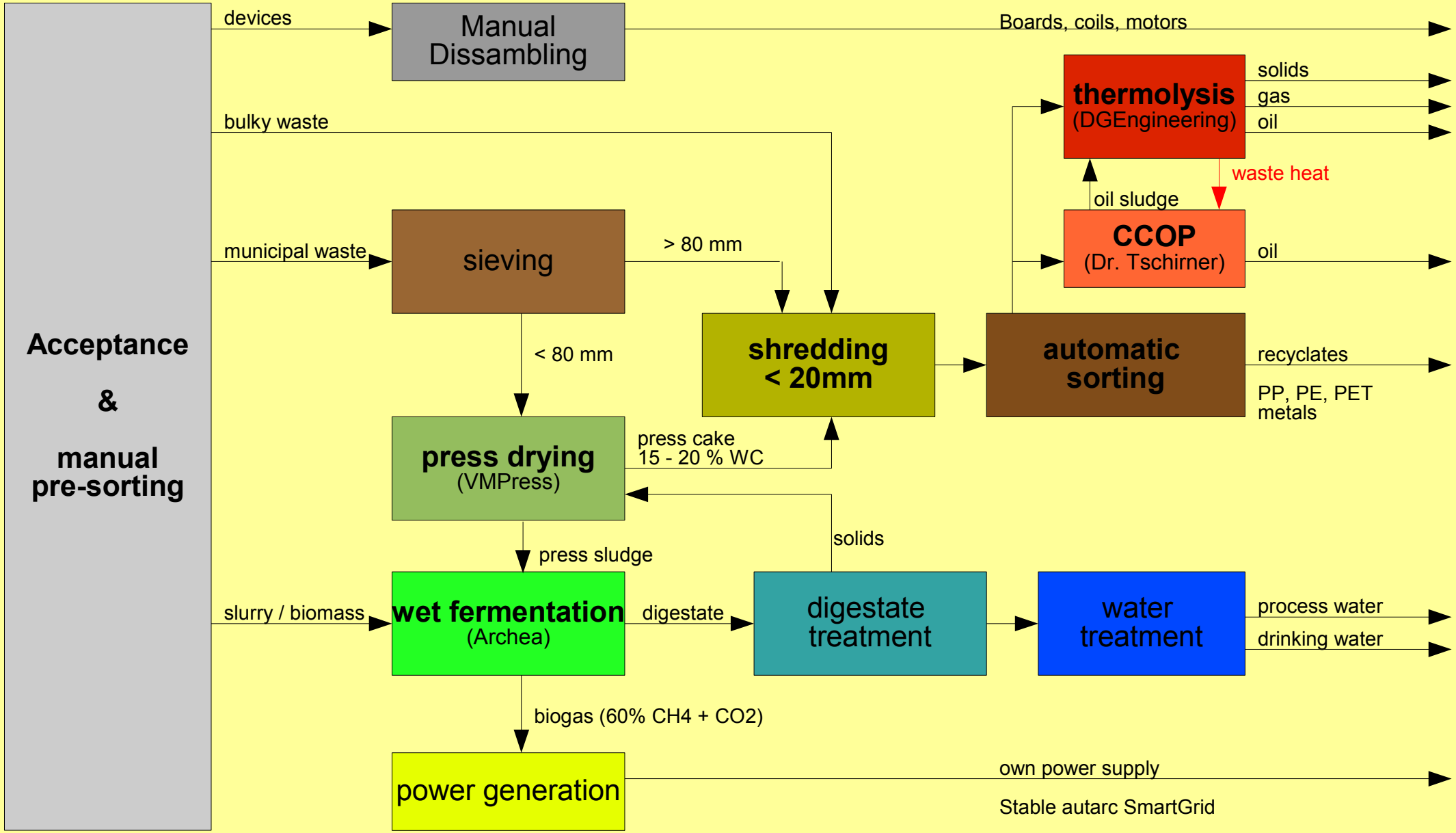
electric power consumption
< 600 kW

free electric power
> 1,200 kW

Consumption:

→ crushing
→ fermentation
→ digest preparation

Flow diagram – T-Rec



Central waste management Kaiserslautern

http://www.zak-kl.de

Technical data:

Press:
throughput 30 t/h 8h/d
→ 240 t/d
→ 60.000 t/a (effective)
→ 180.000 t/a (3-shift)

Biogas-plant:
Fermentation of the pressed sludge

Block heat and power plant:
Power: 2,4 MW
Heat: 4,0 MW

Own usage:
Power: ca. 600 - 800 kW

External:
Processing of the press-cake (15% WC)

Pre-sorting

Sieving

Fine fraction

→ high watercontent
→ high organic content

Rough fraction

→ little watercontent
→ little organic content

Drying by pressing

Technical data:

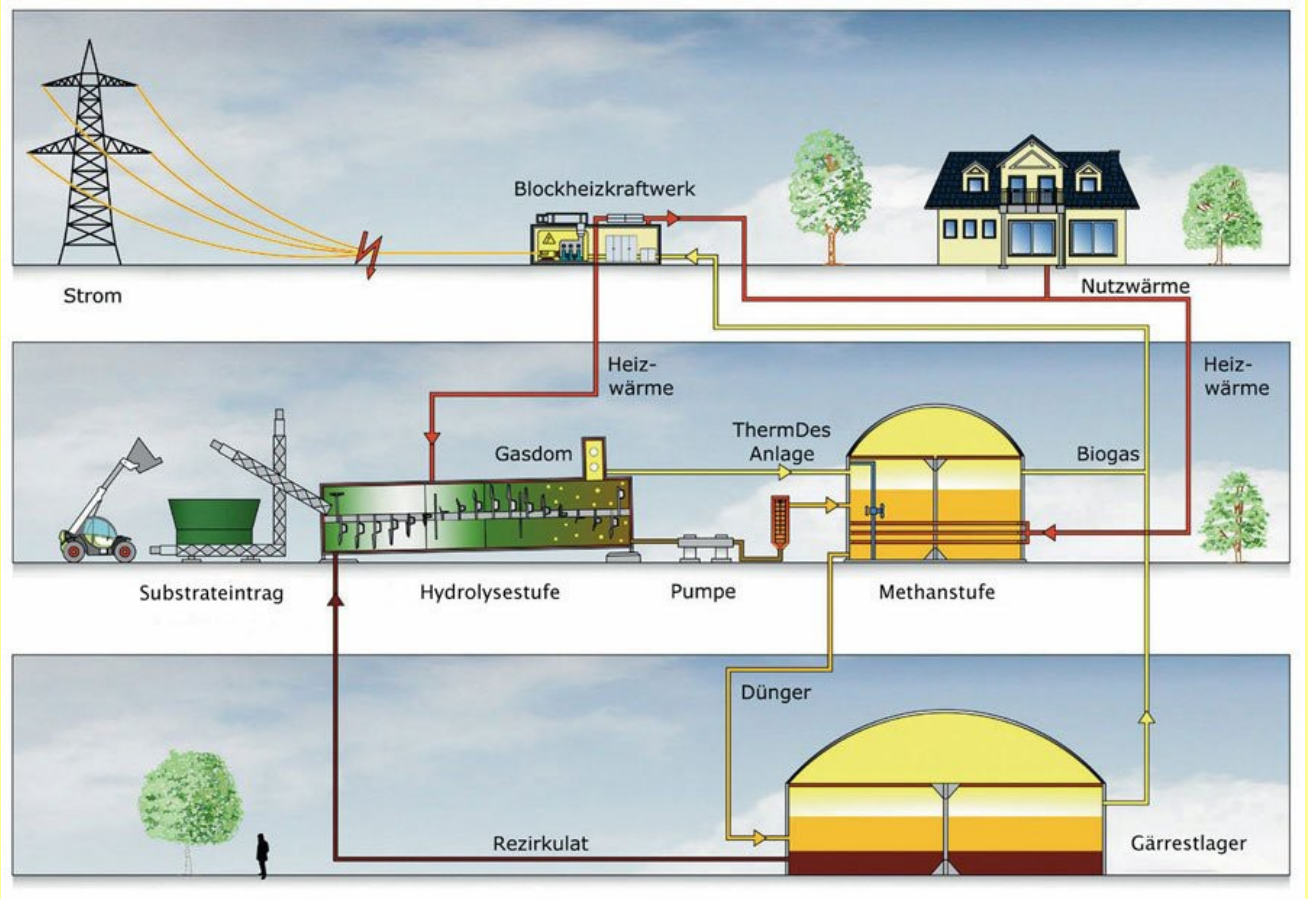
Plant Kaiserslautern

Throughput:	30 t/h
Power consumption:	300 – 400 kW
Original moisture content:	40 - 60%
Moisturecontent after processing:	12 - 20%

Drying by pressing

1 ton waste with 50% WC → 400 kW with thermal drying → 20 kW with press drying

Power out of pressed sludge



Power generation out of pressed sludge

Digestate treatment

Crushing

T-Rec

DGE DGEngineering

Sorting technology

ENERGY EFFICIENCY made in Germany

AMN

Sorting technology – fractions in detail

Target:

- correctly sorted PE / PP / PET / PVC / PUR / …
- correctly sorted NE-metals
- correctly sorted glass (according to colour)
- shreddered and sorted Tetrapak (paper / aluminium / plastic)

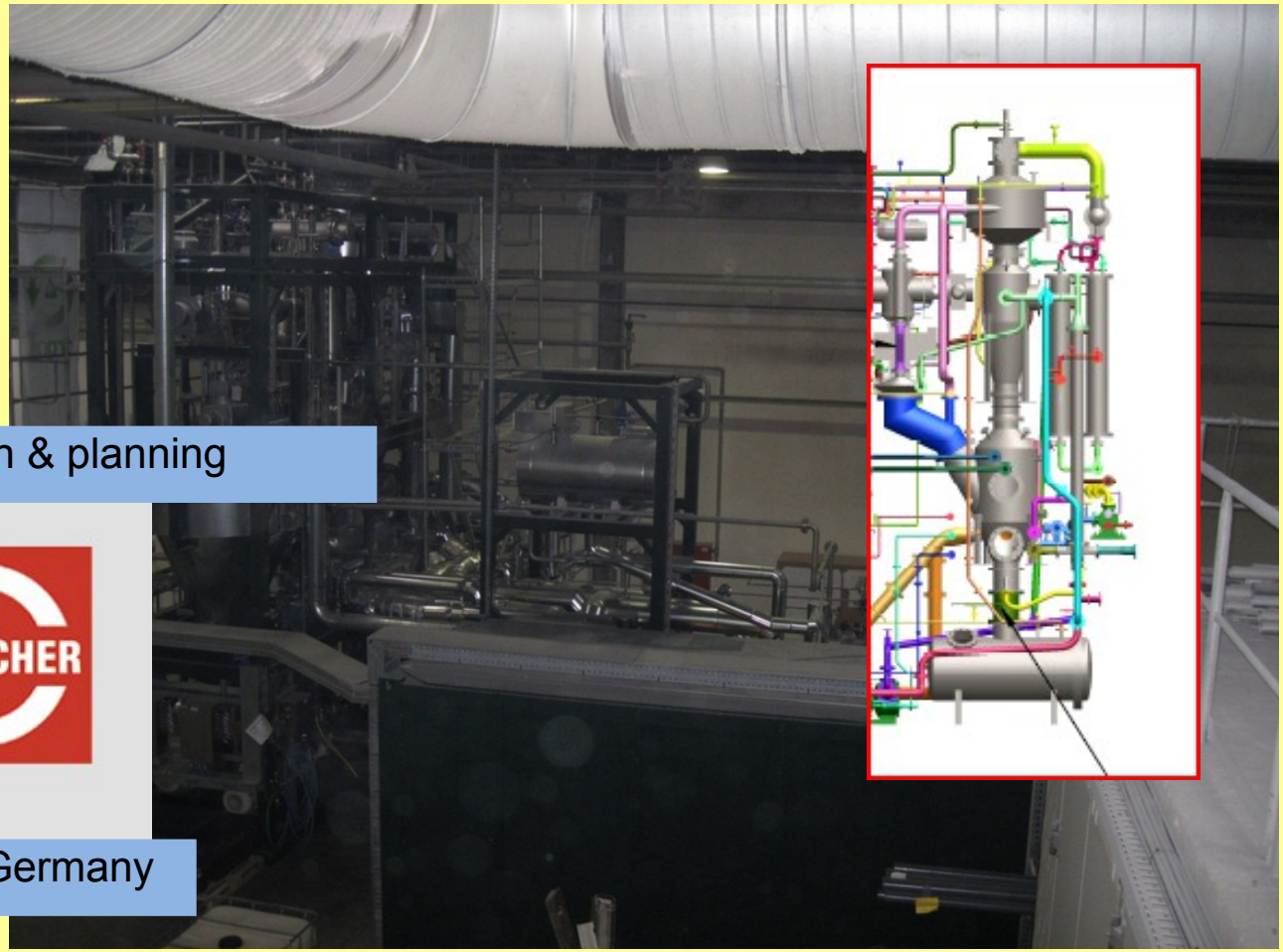
Low-temperature CCOP

Up to 450°C

Technical data:

Output: 200 l/h

Energy demand:
Heat 200 – 380 kW
Power 50 - 150 kW



construction & planning

STREICHER

Gommern/Germany

Patentet by ITC Solution AG - Unternehmensberatung Dr. E. Tschirner

DGE – Rotary kiln thermolysis
over 500°C

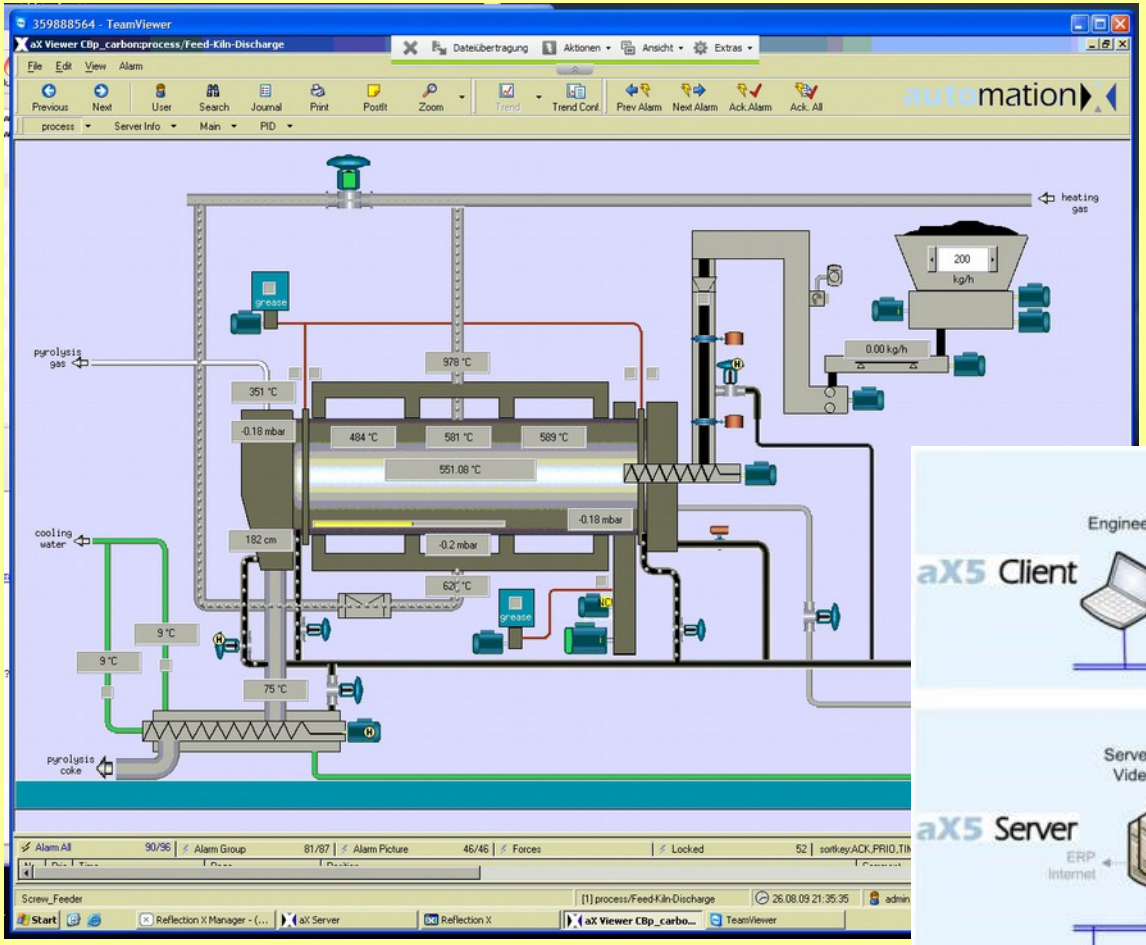
Industrial sludge
120 kg/h
Yokohama / Japan
Since 2000

Matured timber
4.000 kg/h
Mie / Japan
Since 2005

Plastic waste
2x 6.000 kg/h
Hamm / Germany
2001 - 2009

Scrap tire granulate
650 kg/h
Limassol / Cyprus
Since 2009

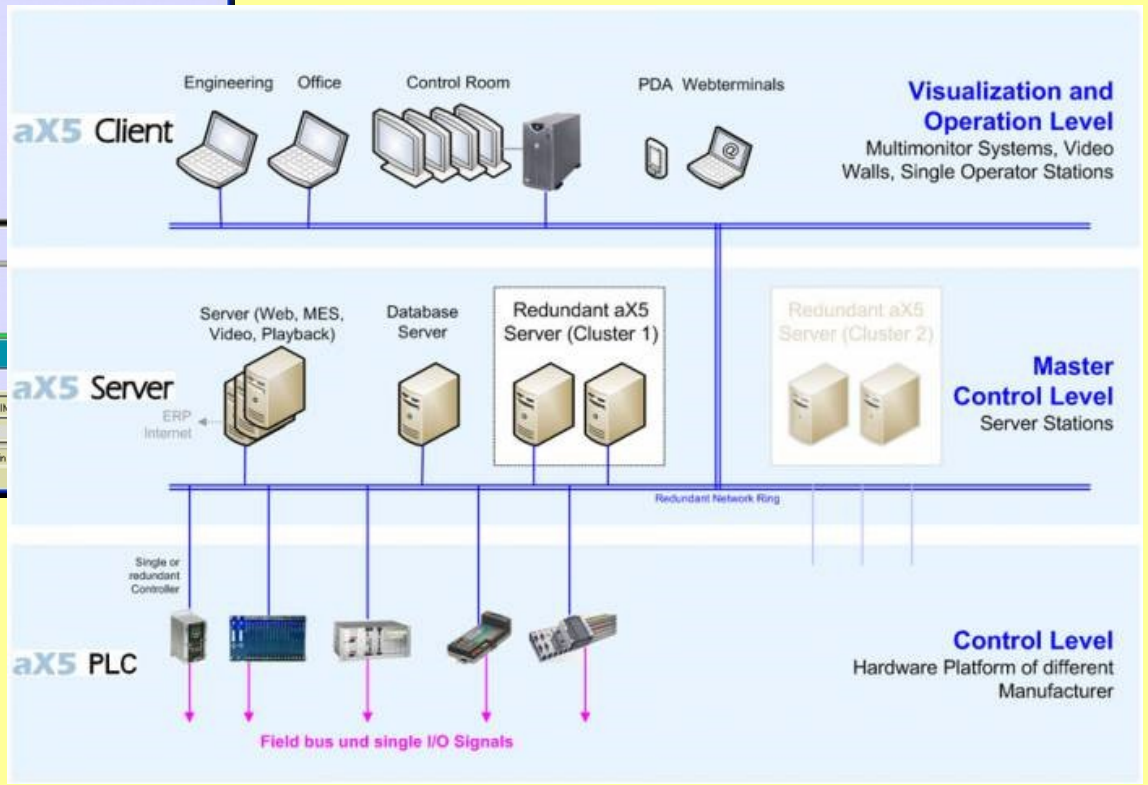
Process control



The AutomationX process control is an approved system.

Our plants are normally controlled by local site engineers.

For maintenance or consulting we offer remote control via internet on demand.



Cost comparison

Basis 100.000 t/a domestic waste

Conventional waste incineration

including pre-hopper, gate firing, steam boiler, turbine, off-gas cleaning, cooling tower

approx. 120 Million Euros

Thermolysis with rotary dryer

including pre-hopper, steam rotary dryer, intermediate hopper, rotary kiln thermolysis plant, burning chamber, steam boiler, turbine, off-gas cleaning

approx. 80 - 90 Million Euros

T-Rec

including

pre-hopper, pre-sorting, press drying, biogas plant, sorting technology, intermediate hopper, waste water treatment, DGE-Thermolysis plant, catalytical cavitative oil production(CCOP), Smart-Grid-process control system

approx. 45 - 50 Million Euros

Because local waste mixtures vary, we recommend a pre-engineering to find a cost- and yield-optimised T-REC solution!

Summary

Pre-sorting
→ Separation of wet material

Pre-sorting
→ energy efficiently drying

Wet fermentation
→ Recycling of press sludge
→ Biogas generation

Generator
→ Power
→ Heat (< 95°C)

Crushing + Separation
→ Metals
→ Glass
→ Plastic
→ Biomass
→ Residual material

CCOP
→ Recycling of plastic compound
→ Oil similar to diesel

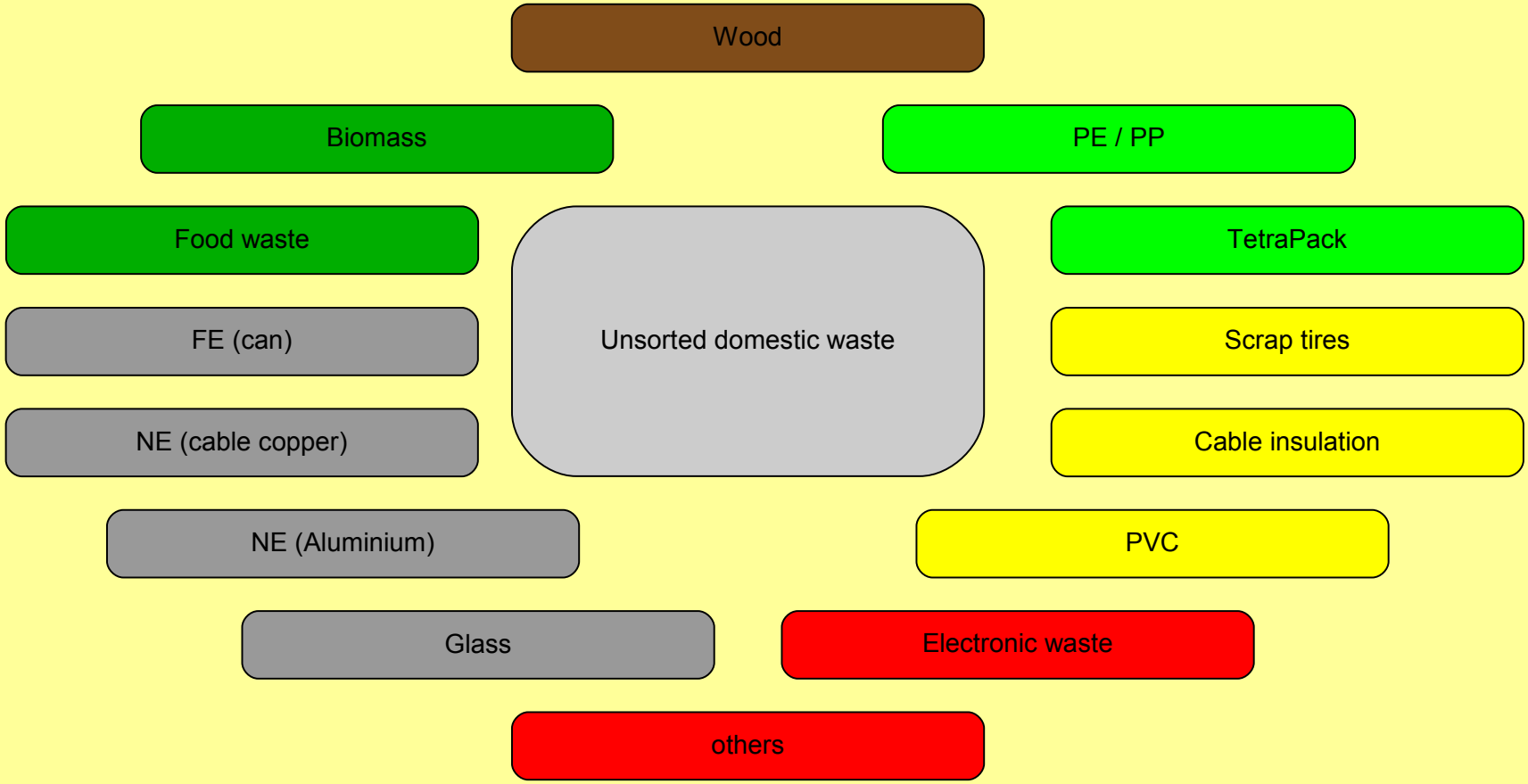
Thermolysis
→ dry coke
→ Heat up to 700°C
→ Gas (H2, CH4, CO, CO2)
→ condensate oils

An interdisciplinary waste management concept!

T-Rec

in detail ...

Basic municipal waste fractions



Exemplary calculation

Compounding	… when delivered		… after drying		Press sludge	
Food	17,0%	17.000 t/a	3,4%	3.400 t/a	90,0%	13.600 t/a
Paper	15,0%	15.000 t/a	10,5%	10.500 t/a	40,0%	4.500 t/a
Plastics						
- PP / PE	12,0%	12.000 t/a	10,8%	10.800 t/a	20,0%	1.200 t/a
- PET	8,0%	8.000 t/a	7,2%	7.200 t/a	20,0%	800 t/a
- PVC	0,0%	0 t/a	0,0%	0 t/a	20,0%	0 t/a
-TetraPak	7,0%	7.000 t/a	6,3%	6.300 t/a	20,0%	700 t/a
-Rest	6,0%	6.000 t/a	4,2%	4.200 t/a	40,0%	1.800 t/a
Rubber	2,0%	2.000 t/a	1,9%	1.900 t/a	15,0%	100 t/a
Textile						
- Plastics	5,0%	5.000 t/a	3,5%	3.500 t/a	40,0%	1.500 t/a
- Natural	5,0%	5.000 t/a	3,5%	3.500 t/a	40,0%	1.500 t/a
Leather	0,0%	0 t/a	0,0%	0 t/a	40,0%	0 t/a
Glass	18,0%	18.000 t/a	17,6%	17.640 t/a	12,0%	360 t/a
Wood	3,0%	3.000 t/a	2,1%	2.100 t/a	40,0%	900 t/a
Metal FE	1,0%	1.000 t/a	1,0%	980 t/a	12,0%	20 t/a
Metal NE	1,0%	1.000 t/a	1,0%	980 t/a	12,0%	20 t/a
Stones	0,0%	0 t/a	0,0%	0 t/a	5,0%	0 t/a
Waste	0,0%	0 t/a	0,0%	0 t/a	40,0%	0 t/a
Sum	**100,00%**	**100.000 t/a**		**73.000 t/a**		**27.000 t/a**

dried down to 10,0%

	Quality A1	Quality A2	Quality B1	Quality B2	Quality C	Recyclate	Metal FE	Metal NE	Glass	Stones
					3.400 t/a					
					10.500 t/a					
						10.800 t/a				
						7.200 t/a				
		0 t/a								
		6.300 t/a								
	4.200 t/a									
			1.900 t/a							
	3.500 t/a									
					3.500 t/a					
					0 t/a					
									17.640 t/a	
				2.100 t/a						
							980 t/a			
								980 t/a		
										0 t/a
					0 t/a					
Digestat					5.400 t/a					
	7.700 t/a	**6.300 t/a**	**1.900 t/a**	**2.100 t/a**	**22.800 t/a**	**18.000 t/a**	**980 t/a**	**980 t/a**	**17.640 t/a**	**0 t/a**

40.800 t/a for thermolysis
7.500 h/a
5,44 t/h is equivalent to 2,7 pcs. MASTER rotary kiln

Output Fermenter	
kW (el.)	1.080 kW
kW (th.)	900 kW

		27.000 kJ/kg Quality A1	27.000 kJ/kg Quality A2	21.000 kJ/kg Quality B1	16.000 kJ/kg Quality B2	8.000 kJ/kg Quality C	
Output							
Coke		+	+	+	+++	+	
Oil		+++	++	++	+	-	
Gas		+	+	+	+	++	
Ash		---	---	---	---	++	
Water		---	---	+	+	+++	

Oil		40.425 MWh/a	33.075 MWh/a	5.542 MWh/a	1.867 MWh/a	0 MWh/a	
		5,4 MW	4,4 MW	0,7 MW	0,2 MW	0,0 MW	
Gas		5.775 MWh/a	4.725 MWh/a	1.108 MWh/a	2.800 MWh/a	25.333 MWh/a	
		0,8 MW	0,6 MW	0,1 MW	0,4 MW	3,4 MW	

Attention: The sated values are only estimated

Waste incineration

Disadvantages

No recycling, only elimination of waste

High effort & spendings on off-gas cleaning to remain below critical values

Filter dust = acutely poisonous waste, origination of secondary dioxins

When processing wet waste with low heating value, expensive additional heating is necessary.

Suboptimal energy efficiency through high effort for steam circuit maintenance

Manual waste processing requires crane operators' know how to ensure failure-free operation.

Out of 100% waste 30% have to be stored in a landfill site


Photo: by Dieter Schütz @ PIXELIO

Advantages

Well-known technology

No sorting necessary

Huge plants up to 780.000 t/a already built in Germany

Approved steam technology for power generation

Complete waste thermolysis plant

Disadvantages

No recycling, only elimination of waste

Residual coke may be toxic waste,depending on heavy metal content of waste

Relatively low throughput quantity up to 50,000 t/a per unit


Photo: by Dirk Gerlach

Advantages

Well-proven since 1982

93% availability in 2010

No sorting necessary

Processing of wet waste (40% WC) without additional heating possible

Emission values significantly below critical values

Cracking of products comprising dioxine

Process temperature only oxygen-free with 700°C, therefore no oxidation of metals

Waste thermolysis, pre-plant

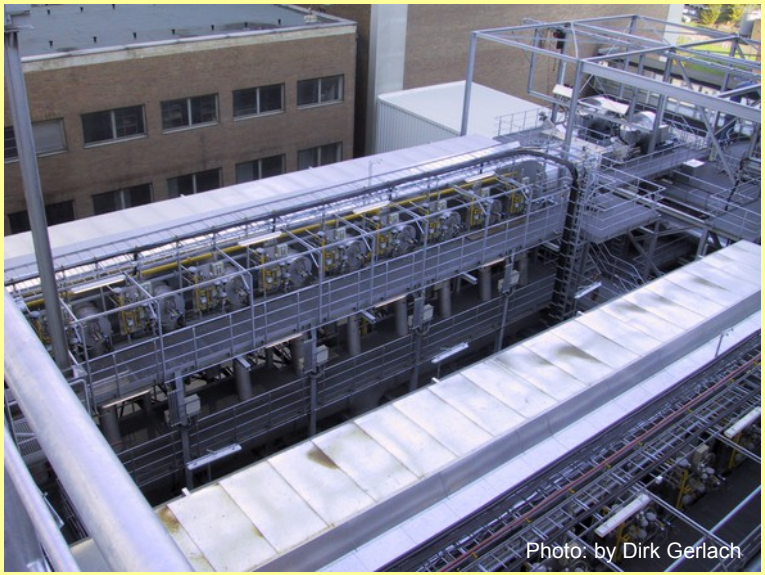
Disadvantages

Pre-sorting recommended

Little recycling products, because only residual coke is treated

Out of 100% waste 5% have to be stored in a landfill

Relatively little throughput up to 50,000 t/a per unit



Advantages

Well-proven since 2001

91% availability in 2008

With 10 MW burner capacity 50 MW processgas is released

No smoke gas cleaning necessary, because it is already available in the existing powerstation

Cracking of products comprising dioxine

Process temperature only oxygen-free with 700°C, therefore no oxidation of metals

T-Rec Recycling concept

Disadvantages

Pre-sorting necessary

More processing know-how necessary:
Pressing, fermentation, sorting and thermolysis

Out of 100% waste less than 1% has to be stored in a landfill

Relatively little throughput up to 15,000 t/a per thermal unit

Advantages

Recyclable and saleable products are generated fully automatically

Optimal treatment of the particular recycling material

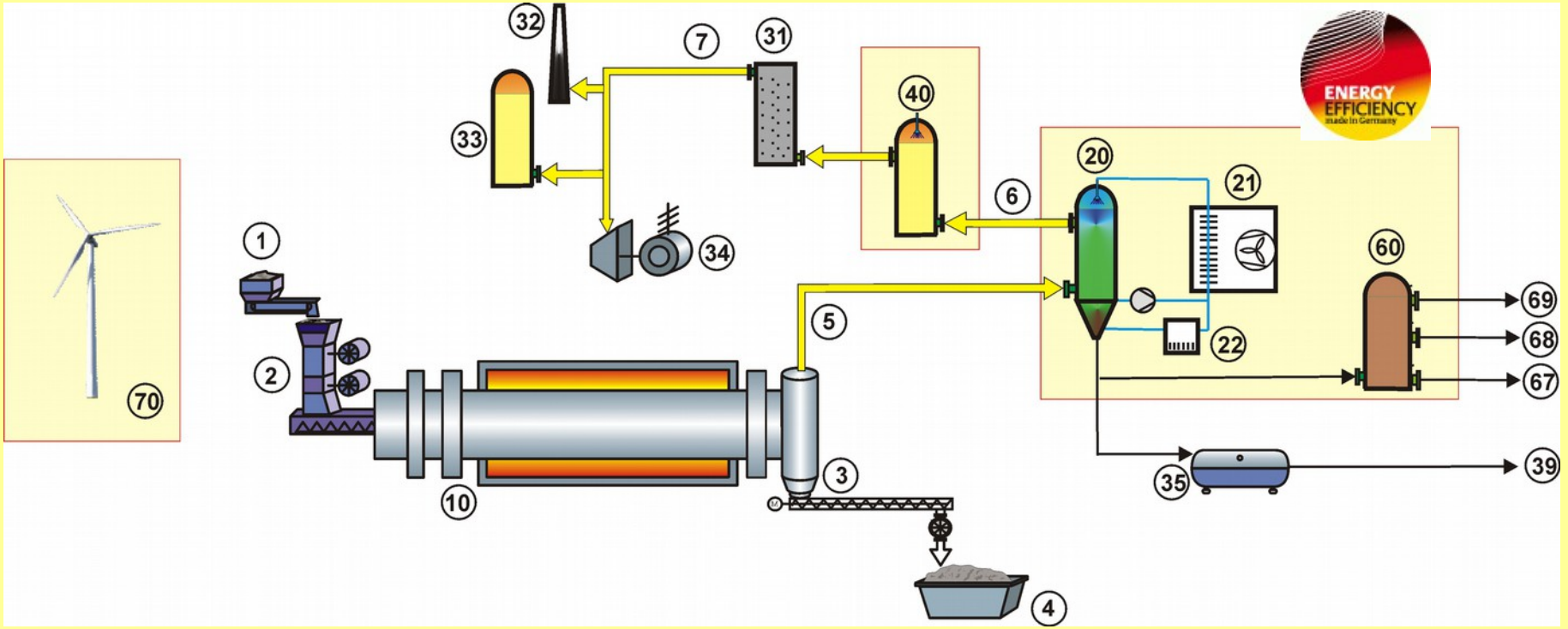
Optimal energetical utilization according to material: fermentation, thermolysis

Secure power generation by means of approved biogas-block heat and power plant-technology

No processing of toxic cocktails, only pure fractions, therefore minimal emissions without off-gas cleaning possible

Profitable operation already possible with 50,000 t/a domestic waste

DGE – Flow diagram thermolysis



1 Hopper
2 Input Sluice
3 Thermolyis coke hot
4 Thermolysis coke cold
5 Thermolysis raw gas
6 Permanent gas
7 Permanent gas, cleaned

10 Rotary Kiln Unit

20 Condensation
21 Cooler
22 Filter

31 Activated Carbon Filter
32 Emergency Flare
33 Gasometer
34 CHP
35 Raw condensate tank
39 Raw thermolysis condensate

Optional:

40 Desulphuring

60 Fractioning

67 Light Fraction
68 Light Oil Fraction
69 Heavy Oil Fraction

Own Power Generation:

→ independend from local net
→ stable power supply of all units, no variation & Cutoffs

Own Gas Supply:

→ independend from local disposability
→ stable gas supply for thermolysis and power generation

Own Water Supply:

→ independend from local water situation
→ connectable with local provider

Own Smart-Grid:

→ independend from local net
→ controls due to the operators requirements
→ connectable with local suppliers

Checklist for basic layout

	amount		water content	heating value
	Menge		Wassergehalt	Heizwert
	[t/a]	[%]	[%]	[MJ/kg]
Food biomass				
paper				
plastics (total)				
- PP / PE				
- PET				
- PVC				
-TetraPak				
- others				
rubber				
textile (total)				
- plastics				
- natural				
leather				
glas				
w ood				
metall ferrous				
metall non ferrous				
stones				
dust from bins				
industrial w aste				
total				