Heat and Power From Biomass and/or Organic Waste

Overview BASURAgas©

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BASURAgas© – Basic Principle and Concept

BASURAgas© has been patented and developed

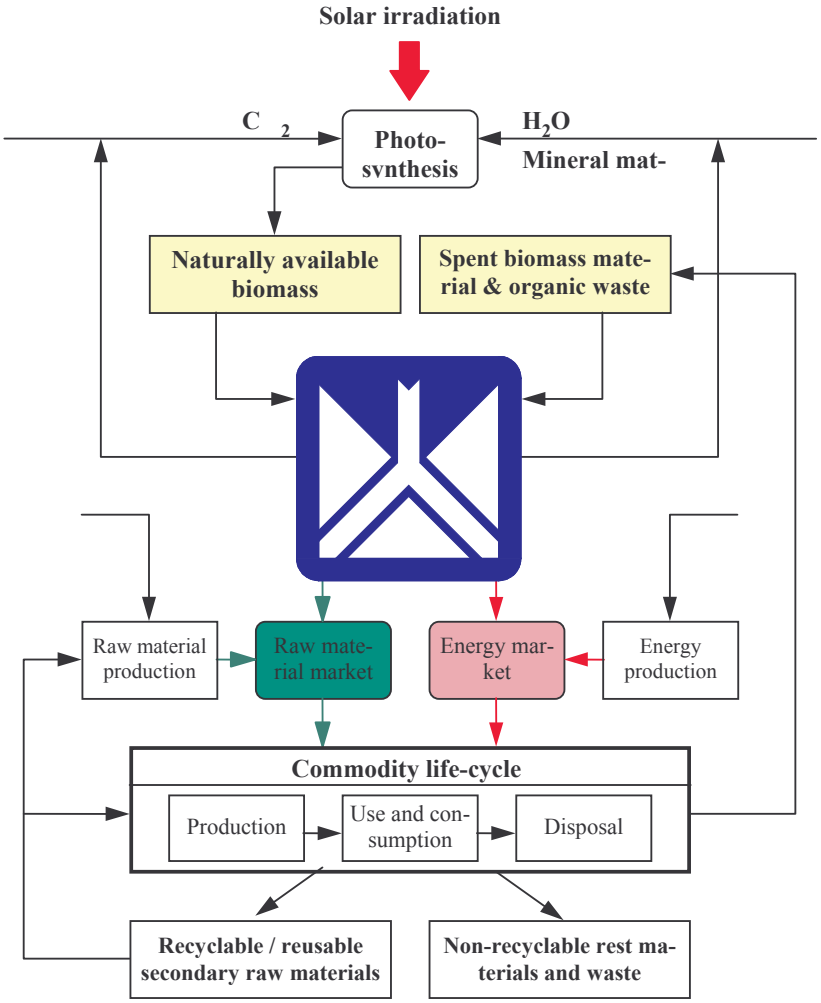
a) To drastically reduce the worldwide increasing flood in waste material and so reduce the need for economically ineffective waste disposal systems with their different collection and disposal implications,

b) To reduce environmental pollution and conserve resources through the optimal production of energy and raw materials from waste material, and

c) To reduce environmental pollution of the air, soil and water

The BASURAgas© system enables the sustainable recycling of waste material and reintroduces the energy and raw materials won through this process back into the production and commodity life-cycle.

The core process involves the gasification of organic (carbonaceous) waste material for the production of synthesis gases which can be used for energy production in secondary processes using special air, gas and water cleansing plants and lean gas combined heat and power plants.



The process of gasification (combustion with reduced oxygen supply) exploits the ability of carbon elements to bind oxygen elements most strongly in order to extract oxygen from a variety of molecular compounds present in waste material with a view to thermally cracking and reducing such compounds.

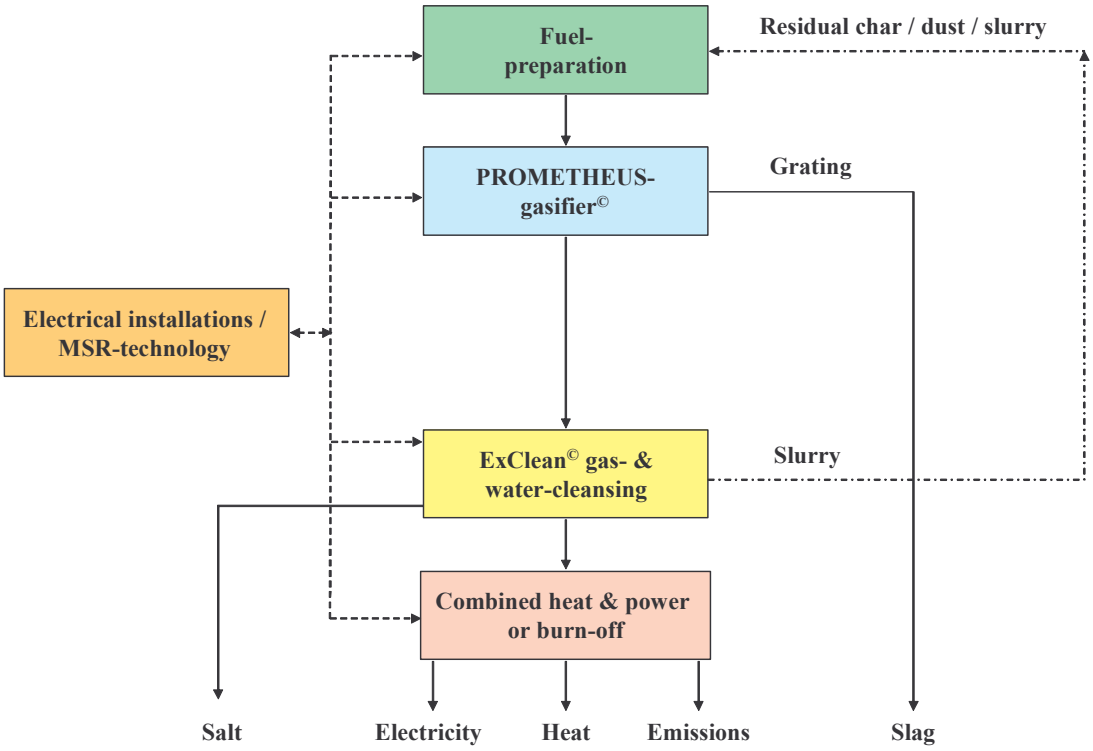
This provides an economic way of obtaining chemically simple molecules and elementary compounds which can be used in practically pure form for the production of new products.

Our plants employ a variety of different approaches in combination in order to convert waste material, contaminated waste, and biogenic remains into energy and raw materials as well as to process raw and secondary materials and waste water of all kinds.

The modular conception of the plants allows the operator to successively expand at a later date (within pre-definable budget and time parameters) in order to incorporate new kinds of waste material processing without needing to revise the overall waste management concept, for example through the addition of waste meat products and biomass processing for energy generation.

BASURAgas© – system and components

The following flow diagram illustrates the basic principle of the BASURAgas© system for generating heat and power. ProCone Gasification Systems GmbH plans and implements such plants from the individual component to complete plants including buildings and necessary infrastructure:



To ensure continual feeding of the gasifier, the fuel must be prepared. Fluctuations in quantity, consistency, moisture and contamination content are balanced out by the plant.

Under the addition of a gasification agent (normally air) the fixed-bed gas generator decomposes the fuel to a combustible gas. Residual minerals and metals are reduced to an inert mass in the form of a glazed slag.

The gas scrubbing/cleansing plant removes dust, tar, condensate and acid components from the gas as well as other contaminants.

The water production produces a concentrate which contains primarily chlorides and fluorides which can be re-used as salts. Any organically heavily-contaminated waste water is evaporated in high-temperature combustion chambers enabling the plant to operate “dry“, i.e. waste-water free.

The heat and power is generated by combusting the cleaned gas product in a so-called CHP-plant (combined heat and power) using optimised commercially available gas engines. Gas need only be burnt off during the powering up and powering down phases of the BASURAgas© plant.

The function and construction of the PROMETHEUS gasifier©

The basic construction of the patented invention consists of a shaft-like counter-current gasifier with fixed bed (counter-current means that fuel and gas flow in opposite directions).

The counter-current gasifier features a rotary rise and fall conical baffle and the hearth is lined with special high-temperature resistant ceramic. This enables an optimal temperature profile and flow balance between gas productions, fuel input flow and grating discharge throughout the entire gasification process.

Through the specific addition of an oxidation agent and the use of high-temperature resistant ceramic, temperatures of up to 2'000 °C can result in the oxidation zone, depending upon the heating value of the fuel. These results in

- the cracking of long-chain hydrocarbons in the fuel (i.e. breaking into its base molecular forms) and conversion into combustible gases, and
- The melting down of mineral and metal residues in the fuel to an inert glazed mass.

The function and construction of the ExClean© gas and water cleansing plant

This patented approach to cleansing raw gas occurs in a series of stages:

- Gas cooling to condensation point in a quench washer
- Toxic gas absorption and fine gas separation in a foam washer.
- Foam decomposition and coarse mist elimination
- Gas propulsion and warming in a rotary piston compressor
- Fine mist and suspended solid separation using an RPS filter.

The wash water from the aforementioned wash cycles is collected and sludge drained off using a decanter. An air cooling system cools the filtrate to ambient temperature levels for re-use in further wash cycles. The drainage level necessary is determined and adjusted as a result pH and conductivity measurements.

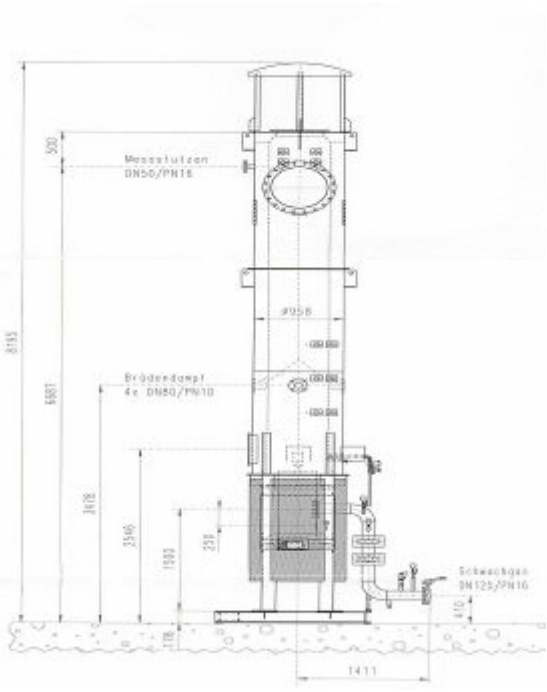
Filter slurry and dusts from the waste water treatment have a total solid content of approx 30 % and contain primarily mineral and metallic components and dust-like carbons from the fuel. Likewise, all tars condensing in the gas washing unit are absorbed and bound by the coal dust and so removed from the gas washing unit. With natural and low-contaminated fuel mixtures it has proven possible to reintroduce the slurry into the gasification process directly.

The chemical composition of the waste wash water in the waste process water tank has been analysed in detail. Due the alkaline pH value of the water (7.5 – 8.5), a slight level of soluble heavy metals has been detected in the waste water. The levels of organic contamination of waste water, present as a phenol content of up to 1.5 g/l and as higher BSB-values, are here the primary concern.

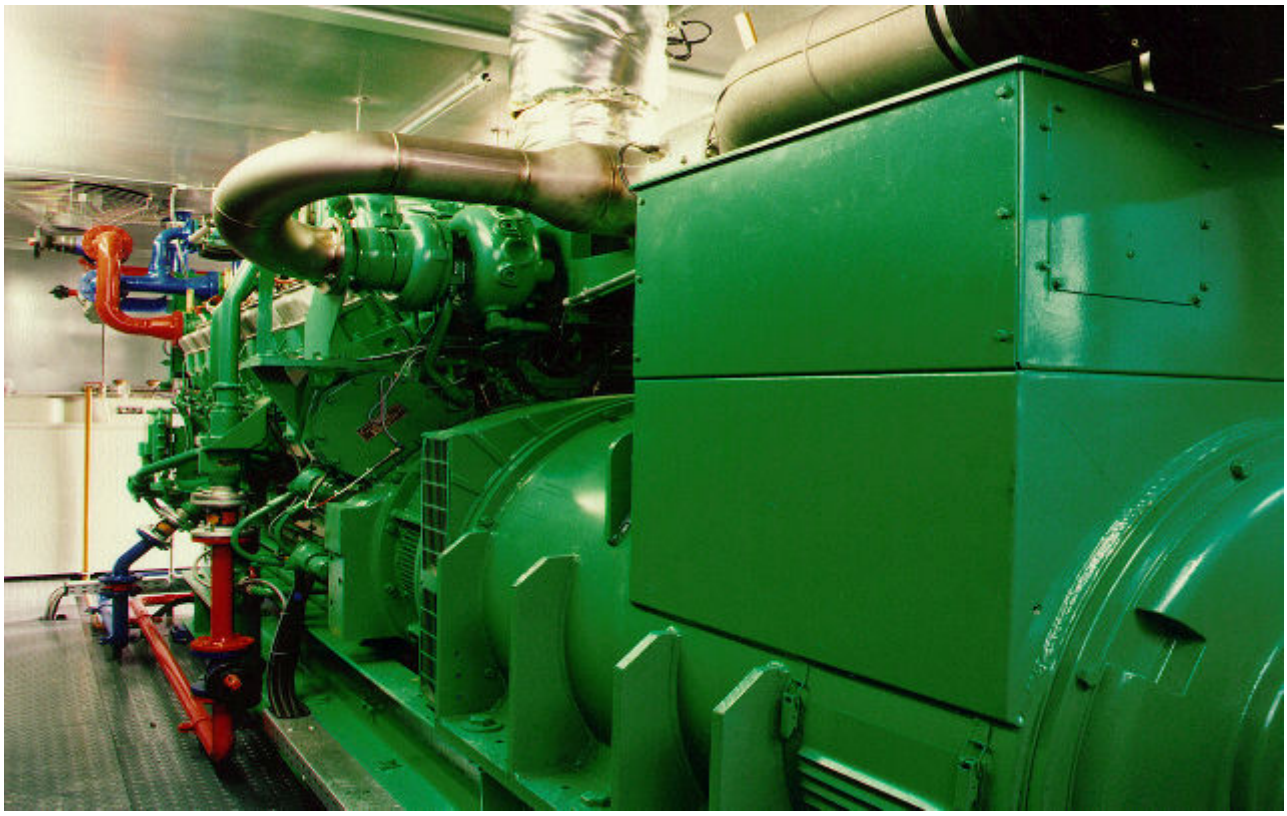
For larger plants (approx. 10'000 t/a fuel capacity) a pre-cleansing of waste water through evaporation and filtration of alkaline components and the binding of these with ammonia (chlorine > ammonium chloride and sulphur > ammonium sulphate) can be advantageous. The treated waste water is then combusted via the powering up flare.

Processing and utilisation of the gas generated with the BASURAgas© plant

A high-temperature flare plant is used to enable the controlled powering up and powering down of the BASURAgas© plant to ensure a constant combustion temperature of at least 1'000 °C.



The heat and power generated using the gas product from the BASURAgas© plant is achieved by combusting the cleaned lean gas in CHP plants (combined heat and power) using optimised commercially available gas generators. The maximum temperature level of the heat produced depends upon the heat requirement. Saturated steam can equally be produced.



Site requirements / supporting input-output infrastructure for BASURAgas©

The following supporting infrastructure for implementing a BASURAgas© plant for combined heat and power out of natural or by-product biomass must be provided on-site by the client and are not included in our cost estimate:

- The plant location: The footprint area required for the plant depends upon the capacity and dimensioning of the plant. A minimum free crane hook height of 18 m must be provided in the area of the plant for the building works, 30 m for chimneys and exhaust flues. The building requires a structurally sound foundation built to sustain the load of the plant and containers.
- Free access ways to and from the plant location must be provided to from the public road network before building works begin. These must be dimensioned for 40-ton heavy-duty truck and trailer.
- Water supply infrastructure should be realised in advance with a minimum of process water quality, with min. 50 mm (DN50) supply pipe cross section. Water pressure should be minimum 6.0 bar or more.
- Resulting waste water is returned to the public sewage system. This should be realised on-site in advance at the lowest point of the plant plot.
- Electrical power transfer point is a high voltage transformer with separate metering for power consumption and power provision. Power distribution from the transformer should be adequate for a voltage rating of 3 x 400/50 V/Hz. The transformer and all electrical cabling must be provided on site in accordance with the local electricity board regulations.

Minimum technical performance expectations of a BASURAgas© plant

For commercial viability, the following minimum technical requirements should be fulfilled:

- Minimum operation period of 1'500 operational hours between maintenance cycles (target value is 2'000 hours)
- Minimum annual plant operation of 250 working days (6'000 h/a)
- Minimum amortisation period and plant life-cycle of 10 years.

In order to be able to fulfil these requirements consistently over time, it is necessary that a constant fuel input of a given quality level is maintained.

Fuel input requirements for a BASURAgas© plant

Appropriate fuel types for material conversion and energy generation are primarily naturally occurring or by-product biomass and waste from commercial or communal refuse collection.

Certain fuel types are not appropriate for use in a BASURAgas© plant:

- Hospital or slaughterhouse/abattoir waste with particular hygienic requirements.
- Radioactive or chemically heavily contaminated toxic refuse or slurry.

For further technical details and calculation purposes, the following norm values or values based upon experience are used for appropriate fuel types:

Permissible feedstock consistency			Dimensions	Unit
- desired	(length x diameter)	=	50 x 50	mm
- maximum	(length x diameter)	>	200 x 80	mm
- minimum	(length x diameter)	>	5 x 5	mm
- proportion	< 5 x 5 mm	<	10.0	%-weight

Permissible fuel composition		Proportion	Unit
- moisture content	<	30.0	%-weight
- combustible organic content	>	35.0	%-weight DS
- contaminant and ash content	<	35.0	%-weight DS

Permissible pollutant levels			Level	Unit
- Chlorine	Cl	<	25,000.0	mg/kgDS
- Fluorine	F	<	2,500.0	mg/kgDS
- Sulphur	S	<	25,000.0	mg/kgDS
- Mercury	Hg	<	2.5	mg/kgDS

Exhaust gas emission levels for BASURAgas© plants

The compliance with max emission target levels for exhaust gases can be guaranteed in full, provided that the plant is operated with a fuel as defined above (German gas emission levels):

- Total dust	Dust	<	10.00	mg/Nm³
- Total carbons (as sum organic compounds)	C	<	10.00	mg/Nm³
- Hydrogen chloride	HCl	<	10.00	mg/Nm³
- Hydrogen fluoride	HF	<	1.00	mg/Nm³
- Sulphur dioxide	SOx	<	50.00	mg/Nm³
- Nitrogen oxide	NOx	<	200.00	mg/Nm³
- Mercury	Hg	<	0.03	mg/Nm³
- Carbon monoxide	CO	<	50.00	mg/Nm³
- Total dioxins and furans	PCDD/F	<	0.10	ngTE/Nm³

In addition to the emission levels, regulations demand that the plant must provide a minimum heat input of 350 kW because the combustion of refuse material in small plants is not permitted.

Requirements for ash and slag waste products from BASURAgas© plants

The resulting slag is practically fully inert (ignition loss << 1.0 %). Heavy metals must be bound within the residue without risk of leaching. The statutory leach ate limits for the respective landfill waste classes must be fulfilled.

Slag should be disposed of within national borders in surface landfill sits, mineral material dumps or toxic waste disposal sites depending upon the contaminants contained and their levels (in turn dependent upon the fuel used). Alternative future means of reprocessing the slag are currently being investigated as the raw material content of the slag is similar to that of natural ores.

Waste water requirements for BASURAgas© plants

In order to fulfil waste water regulations for public sewage networks, the hygiene of all condensate and waste water from the gas cleansing and waste water treatment process of such plants must be ensured.

In addition local waste water discharge limit values as given by the local sewage works should be consulted and fulfilled.

Other waste materials from BASURAgas© plants

Due to the comparative simplicity of the plant and the processes implemented, further waste materials are not to be expected.

Most notably the repeated treatment of vapours and steam at temperatures of over 1'000 °C should obviate the need to treat for odour emissions.

Noise pollution and the environment

Due to the small dimension of the plant and its practically noiseless operation, no noticeable noise emissions are to be expected from the plant itself.

Noise intensive components of such plants are more likely to be associated machinery such as shredders for pre-processing fuel. Such machinery does not usually exceed normal daytime values for industrial estates and commercial areas.

If plants are to be constructed in the vicinity of residential areas, such machinery must be contained within buildings which reduce noise emissions to a level below that of statutory levels for residential areas.

Traffic and transport to and from BASURAgas© plants

The concept of decentralised waste processing aims to reduce the economic cost and environmental impact of logistics, transport and traffic by processing waste as near as possible to where it occurs.

As a result traffic and transport emissions are reduced, as only waste material from the immediate vicinity is processed in the plant.

Realisation process of a BASURAgas© plant

The following table details a road-map for the realisation of the proposed BASURAgas©-plant in four stages:

Realisation stages			Duration
Stage 1 – General planning			**3 months**
Phase I	Project phase		3 months
	TL 1	Building project	
	TL 2	Preparation of planning approval	
Stage 2 – Detailed planning			**3 months**
Phase II	Working planning		3 months
	TL 3	Detailed specification	
	TL 4	Detailed time planning	
Stage 3 – Realisation			**6 months**
Phase III	Realisation / planning		
	TL 5	Working drawings	3 months
Phase IV	Realisation		3 months
	TL 6	Workshop assembly	
	TL 7	On-site construction and assembly	
	TL 9	Building supervision / specialist supervision	
Total delivery schedule – Plant			**12 months**
Stage 4 – Completion			**12 months**
Phase V	Concluding phase		approx. 3 months
	TL 10	Begin of operation / control / monitoring	
	TL 11	Cost appraisal	
	TL 12	Revision of documentation	
Phase VI	Guarantee phase		12 months
	TL 13	Guarantee period	
Total delivery schedule – entire plant delivery			**24 months**

The proposed time plan details solely our own time requirements. The duration of services to be brought by third parties are not included and can in certain circumstances lead to significant delays in the overall realisation period.

These can include the time taken to obtain planning approval from the planning authorities, the duration of necessary preparatory works necessary to build and decision-making time requirements on the part of the client.

Risk-Management and the realisation of a BASURAgas© plant

The manufacture and operation of a BASURAgas© plant necessitates considerable investment and a contractual relationship between the manufacturer and builder and the buyer and operator over an extended period of time. As such it is necessary to secure both technical and commercial risks during the realisation and operation of a plant through so-called multi-risk insurance cover:

Basic insurance cover

The following insurance cover is advisable in all cases:

➢ Manufacturing risks	- Client liability cover - Transport insurance - Combined construction and assembly insurance - Manufacturer guarantee insurance
➢ Operational risks, technical risks	- Machine insurance
➢ Business risks	- Fire insurance cover - Theft insurance - Water damage insurance - Environmental damage insurance (elements)
➢ Assets insurance	- Operational interruption insurance
➢ Further operational costs	- Further operation guarantee insurance

Additional insurance cover

In addition the following risk cover is also advised:

➢ Third party and person insurance	- Operational liability insurance
➢ Contractual liability	- Surety provision insurance
➢ Creditworthiness risk	- Debtor insurance

The kind of insurance cover chosen, the parties responsible and the time at which they come into effect depends on the contractual and commercial conditions of the insurers as well as not least on the nature of the agreed contract between the realisation partners.

Energy-Contracting

The simplest and most efficient contractual situation arises where the plant is realised via energy contracting as the contractor is typically the only insurance policy holder! In this case insurance is then usually provided by a single insurance company.

Summary of the BASURAgas© plant

The BASURAgas© plant was conceived

a) To drastically reduce the worldwide increasing flood in waste material and so reduce the need for economically ineffective waste disposal systems with their different collection and disposal implications,

b) To reduce environmental pollution and conserve resources through the optimal production of energy and raw materials from waste material, and

c) To reduce environmental pollution of the air, soil and water.

The distinguishing features of the BASURAgas© plants are as follows:

- A plant for the sustainable recycling (energy and material) and reprocessing of all applicable waste materials and the reintroduction of energy and raw materials won through this process back into the production and commodity life-cycle.
- The use of naturally occurring resources as a CO2-neutral energy source.
- Decentralised installation near to point of fuel source:
  - Elimination of transport costs and association environmental impact.
- Processing of most typical waste products
  - low waste fuel preparation costs
  - minimal waste separation requirement
    - to remove mineral and metallic components
    - to separate natural waste from contaminated waste
- with high temperature PROMETHEUS gasifier© for:
  - low fluctuation gasification process despite heterogeneous fuel input material
  - gasification efficiency > 95 % (thermal), > 85 % (chemical)
  - Inert, leach-free slag (ignition loss < 1 %)
  - cracking/splitting of complex hydrocarbon compounds
    (Tars, phenols, dioxins, PCP, PCB, etc.)
  - simple, cost-efficient components for fulfilling statutory emission reduction requirements (e.g. 17th federal emissions reduction law, technical guidelines for air purity)
  - simple, cost-efficient components for processing resulting gas condensate
- **Energy output (electricity, heat/cooling) up to 90 %**
- **Electrical efficiency (electricity only) up to 45 %**
- Gas processing in commercially available gas engines and generators
- Extensive automation enables unattended operation
- Technical risk cover is insurable
- Secure disposal of plants after useful operation lifetime
- **Commercially viable through the continuous production of energy**
  - min. 6,000 operating hours per year
  - Fuel yield min. 24 t / d