

"I do not believe that global problems can be solved globally. Nature also solves global problems by changing something locally in such a manner that gradually grows into larger dimensions"

Hans-Peter Dürr (1929 - 2014), German physicist

Solve global problems locally – with pyrolysis and biochar

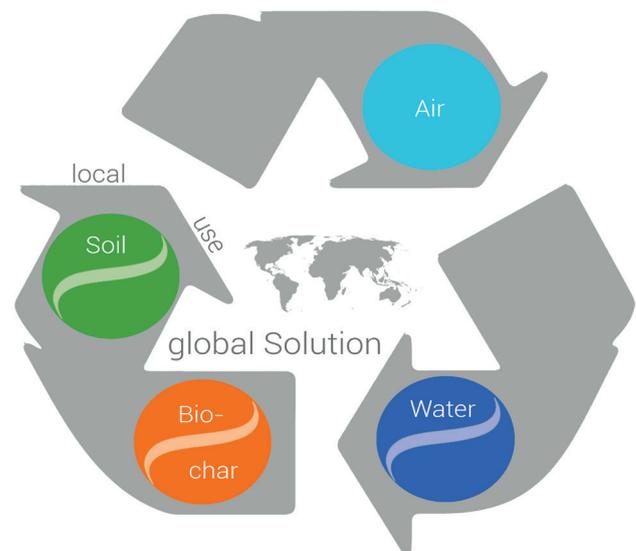
A technology which improves soil, water and air. This will be able to reduce and bind greenhouse gases locally and worldwide. This benefits both the national economy as also the acting parties on the basis. Therefore a solution to the climate challenge in which there are no losers. Is this possible? We, the gara energy systems, say yes. We favour and have found an answer which is ecologically and economically sensible and forward looking: *The answer is pyrolysis & biochar.*

Climate change is the key issue for the future of all of us. The challenges are current, acute and enormous – from energy problems to global nutrition issues, from degradation of soils to sea-level rise. To bring the ecosystem into balance we now need sustainable concepts.

For more than 13 years gara has been a well-established company, dealing in agriculture and water technology. With gara energy systems a sister company was founded in the business group to complete the spectrum of action fields adequately. gara energy systems therefore specializes in energy, agricultural and environmental questions. Here, gara especially, has the major interfaces of the environment in view: soil, water and air. The solution which gara energy systems has developed is a connection of two combined components:

- a) pyrolysis plants for biomass the production of high-quality biochar and
- b) application of high-quality biochar.

A combination which is just as useful for the agriculture and forestry, as for their economy, for the climate and environment as well. Both sides are involved – biomass input material, output products and their use in those industries.



economical closing of the natural loop

The principles of this pyrolysis and use of biochar have been known for thousands of years. gara puts them into a new context and through the use of biochar closes respectively stabilizes the natural cycle.

In the pyrolysis process – of up to 600°C – organic residue and waste materials are transferred into high-quality products – among other things biochar and pyrolysis gases. The products can be marketed by the producers, also energy and heat, whereas the gases can also be used for an autarkic energy supply. High quality biochar is in the focus of the process which is also a basic product for activated carbon. The effects of this tested and long-term proven technology are elementary. The produced high-quality biochar can be used as a valuable additive for the soil, plant growth and plant health with best effects.

Our pyrolysis technology

- converts organic residual materials into valuable products
- produces biochar, which favours soil, environment and climate a long time
- can contribute to bioenergy production (energy and heat generation)
- operates „CO₂-negative“, therefore reduces this climate gas through use of biochar
- offers agriculture an economically consistent alternative



The biochar

- serves as soil additive for agricultural areas
- supports the soil structure – reduces the soil degradation or erosions
- improves environment for aerobic microorganisms – encourages humus formation
- optimizes moisture storage – water balance in soil & so prevents waterlogging and drought
- increases soil aeration – reduces siltation of the soil
- improves soil fertility – stores nutrients and reduces need of fertilizers
- reduces costs and increases yields – has a positive effect on economy
- deprives the environment CO₂ through binding the carbon from biomasses
- protects groundwater – immobilization of pollutants and loss of fertilizers
- serves as ideal CO₂-sink and ensures a long-term CO₂-sequestration
- can be used as a substitute for fossil coal in power plants



Enormous Potential

The gara-solution approach "pyrolysis & biochar" generates synergy effects between climate protection (Kyoto) as also soil conservation and economically links the involved questions agriculture, soil quality and energy. Therefore, besides the agricultural use, biochar fulfils all criteria for a successful "geo-engineering" and exceeds all expectations of a "simple climate engineering".

The production is based on biomass, a "regenerative good", which can be used in a sustainable manner. Globally the annual carbon absorption in biomass is assumed more than 120 gigatonnes.

There remain huge amounts of carbon bound in plants and wood, of which great amounts "decay" in nature. In Germany a technical-environmental potential on biomass by-products is assumed to be in forestry and agriculture, municipalities and in the food industry, which is approx. 90 million tonnes of dry matter per year. The theoretical amount of dry matter is assumed to be 125 million tonnes per year, from which we can justify the volume flow for our pyrolysis plants.

Leading scientists consequently recognise a win-win-win situation in the use of pyrolysis and biochar: environment & nature, social & national economy, agriculture, forestry and energy industry benefit jointly.

Technology of the future

The gara energy systems strives for the construction of flexible pyrolysis plants (particle size, quantity, quality of the biomass, process time) and the marketing of high quality biochar. gara is convinced that this solution will also achieve sustainable effects in the field of greenhouse gases. gara has a well-proven pyrolysis technology, which over many years of application has been optimized and patented.

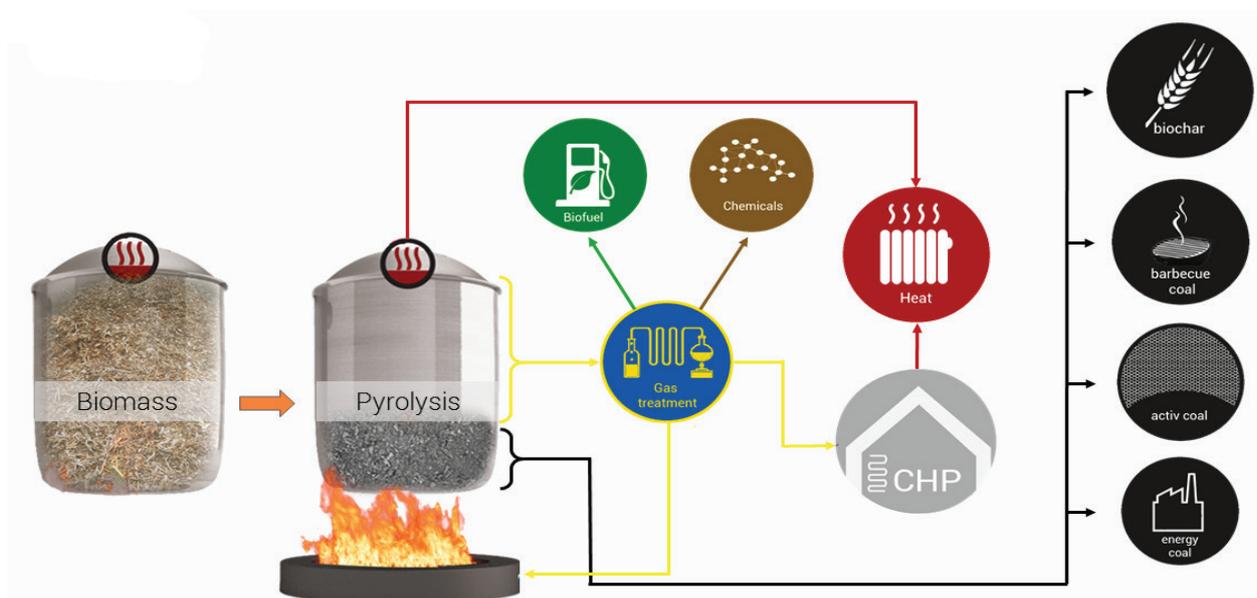
Basis is an oven & retort system with parallel operating retorts. The effective and controlled pyrolysis process takes place in an approx. 5 m³ big "pyrolysis room". The produced biochar reaches – depending on the biomass – carbon contents of 80 % and more. Thus, the biochar remains stable in the soil and will not decay over a period of e.g. thousands of years. A role model was the historic Terra Preta of the Indigenous Peoples in the Amazon region.

The pyrolysis process is completely climate-neutral. Through the use of biochar in the agriculture the balance is CO₂-negative (withdraws successfully and sustainably CO₂), therefore positive for greenhouse gas effects and the environment. No other regenerative energy system (wind, solar, biomass power plant) can achieve this – at best they are "CO₂-neutral". The construction and operating underlie the standard approval procedures, whereby no objections can be seen during operation. The plants comply with all the requirements of the German Federal Immissions Control Act and the corresponding regulations.

A gara-pyrolysis-plant with 24 retorts produces about 12.500 t per year of high quality biochar from up to 56.000 t/a biomass. The biomass can be provided from forestry or agriculture as well as e.g. the food industry. During the gara-pyrolysis – processing time of up to several hours – biochar and pyrolysis gases are generated. The energy supply is self-sufficient (autarkic), up to 50% of the energy-rich gases are used for the pyrolysis process, the rest can be used to produce energy (heat/electricity) in a heating system or in a combined heat and power plant (CHP).

In a pyrolysis plant (24 retorts; CHP-operation) we reckon with an hourly yield of up to 1.5 MWeI (electricity) and more than 1.9 MWth. (heat).

The achieved climate effect is enormous. Biochar, used in agriculture, accelerates a permanent sequestration of CO₂ – and also has a positive effect on further greenhouse gases (methane and nitrous oxide). With 12.500 t of biochar, 10.000 t of carbon or 37.000 t of CO₂ can be stored in the soil for an extended period of time. This is equivalent to a distance covered by a standard car of approximately 250 million kilometres. „The Economist“ (2009) suggests, that through the use of biochar – especially as a substitution for fossil fuels – a reduction of between one and two gigatonnes of CO₂-emissions of the current annual emissions of some 9.7 gigatonnes might be achieved. This would be between 10 to nearly 20 % of the worldwide emissions, which underlines the possible importance of pyrolysis and the use of biochar.



Global solution

Solely the biomass residual materials (wood residues and small diameter logs, weak wood etc.) of 12 million t/a or the 5.7 million t/a of sawmill by-products from the forestry in Germany (both technological-economic potential @ dry substance) show, that a biomass input-materials market is apparent. This would permanently secure the supply of more than 300 pyrolysis plants – each with 24 retorts. Biomass from other sectors of the forestry and agriculture and from uncontaminated waste management has not been included in the calculation of the number of pyrolysis plants. Also the use of sewage sludges has intensely been reflected in this overview but has not been considered in the calculation.

One to five tonnes of biochar per hectare of agricultural land can be usefully incorporated into the ground. The total agricultural area in Germany amounts to some 16.7 million hectare. Biochar not only has a huge potential as CO₂-sink, it is also an enormous sales market in agriculture. Worldwide the agricultural area is stated to be nearly 50 million km² (5 billion ha). These vast areas could be upgraded usefully – and may generate promising results. This shows that biochar, despite its regional character, can contribute to a global solution.

Combining the economic and environmentally relevant advantages we see a real opportunity to place our pyrolysis technology on the market. Each of the plants offers the operators and users an economic alternative and furthermore helps to improve the climate footprint. Possible CO₂-certificates or other financial incentives for production or use have not been considered in our economic calculation. The pyrolysis plant doesn't finance itself through feed-in remuneration like biogas plants, but through an economic sustainable management concept. The calculated investments, operating costs and revenues are very convincing for us.



Raffael Schindele, managing director of gara energy systems, is convinced: "Sustainable questions regarding the agricultural, energy and environmental economies should be solved regionally – it would support the local economy, protect the environment, and would integrate the general public and fellow citizens into a positive circuit. In the combination biomass & pyrolysis & biochar I only see winners - not only in the short term but especially in the long term."

