Energize Your Waste

HYDROTHERMAL CARBONIZATION (HTC) AND VAPORTHERMAL CARBONIZATION (VTC). KEY TECHNOLOGIES IN GLOBAL WASTE TREATMENT

Alfons Kuhles, GRENOL GmbH

It´s a dirty job, but we made it!

- GRENOL GmbH, is founded 2007 and the **eldest company** in the market of HTC.
- Founding father & **CEO**: Dipl. Agrar Eng. **Alfons Kuhles**, seat Ratingen (Germany).
- GRENOL GmbH is founding member of the Bundesverband HTC, since 2011.
- GRENOL GmbH makes **plant advancement** and identifies the **best periphery units** over the years.
- The **price winning** GRENOL company has a **dedicated, friendly team** and a wide range of support partners.

KYOCERA Umweltpreis
KYOCERA
Gewinner 2012

Energy Globe
The world award for sustainability
National Energy Globe Award Germany 2016
1st place


First Batch 2,5L (2007)


Conti-Reactor 250 l (2008)


ZHAW Batch 25 l (2009)

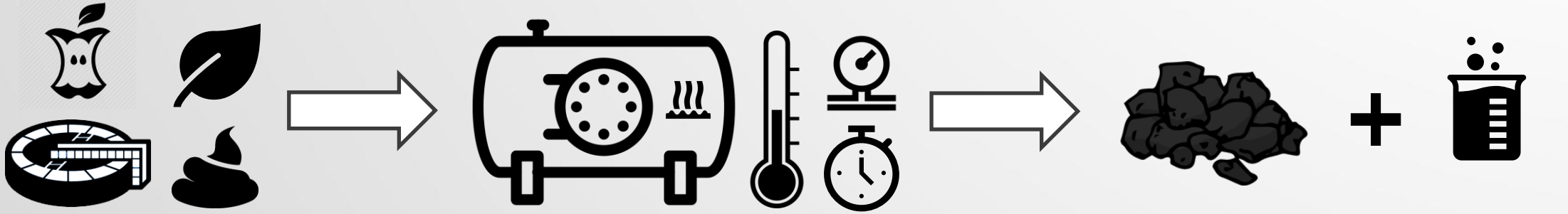

Demonstration Reactor 0,25 m³ (2010-2011)


Industrial HTC-Reactor 2,5 m³ (2012-now)

What is the HTC / VTC Technology?

Hydrothermal/Vaporthermal Carbonization (HTC / VTC) is the conversion of biomass into coal and water in a closed system under conditions of temperature and heat within several hours, like in the earth in million of years.

- HTC / VTC is conducted at a temperature of about **230 °C** and ca. **25 bar** pressure.
- HTC / VTC is a **physical-chemical procedure**, not biological process.
- By breaking up the carbohydrate chains to carbon and water, heat is released (**exothermal process**).
- The carbonization process occurs within **short time (2-6 hours)**
- **HTC** is for the use of **fluid waste** materials (< 30% dry matter (DM)) and **VTC** is for the use of **solid waste** (> 30% DM)

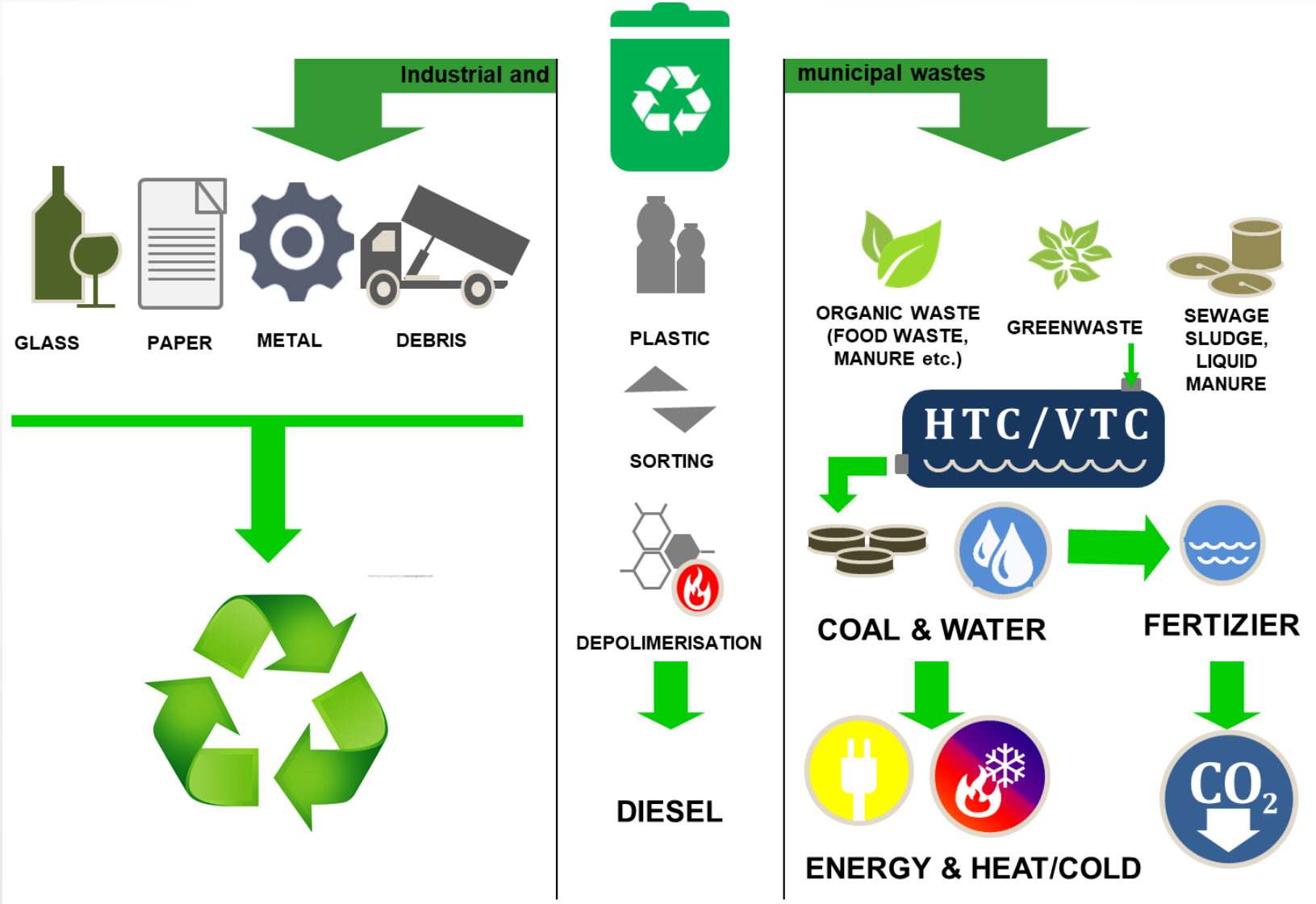


Why should we use the HTC / VTC Technology?

Answer:
To close the cycle of waste management, worldwide.

At the moment organic waste is not used wisely.

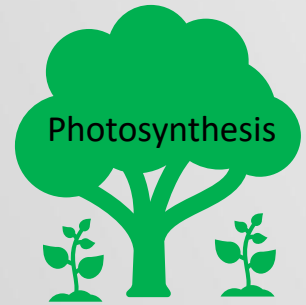
Along with the conventional methods of biomass conversion, there is always a discharge of the climate damaging carbon dioxide (CO_2) and a bad carbon efficiency.



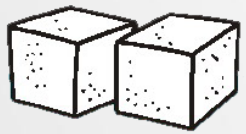
Where are the differences between HTC / VTC and other processes?

Energy

+ CO_2



+ H_2O



Biomass consists for the most parts of carbohydrates like - **Sugar ($C_6H_{12}O_6$)**

+ oxygen

Combustion

Carbon efficiency = 0%

(6 H_2O + 6 CO_2 ↑)

Fermentation

Carbon efficiency = 65%

(2 C_2H_5OH + 2 CO_2 ↑)

Alcohol

Landgas process

Carbon efficiency = 50%

(3 CH_4 + 3 CO_2 ↑)

Methane

HTC / VTC-process

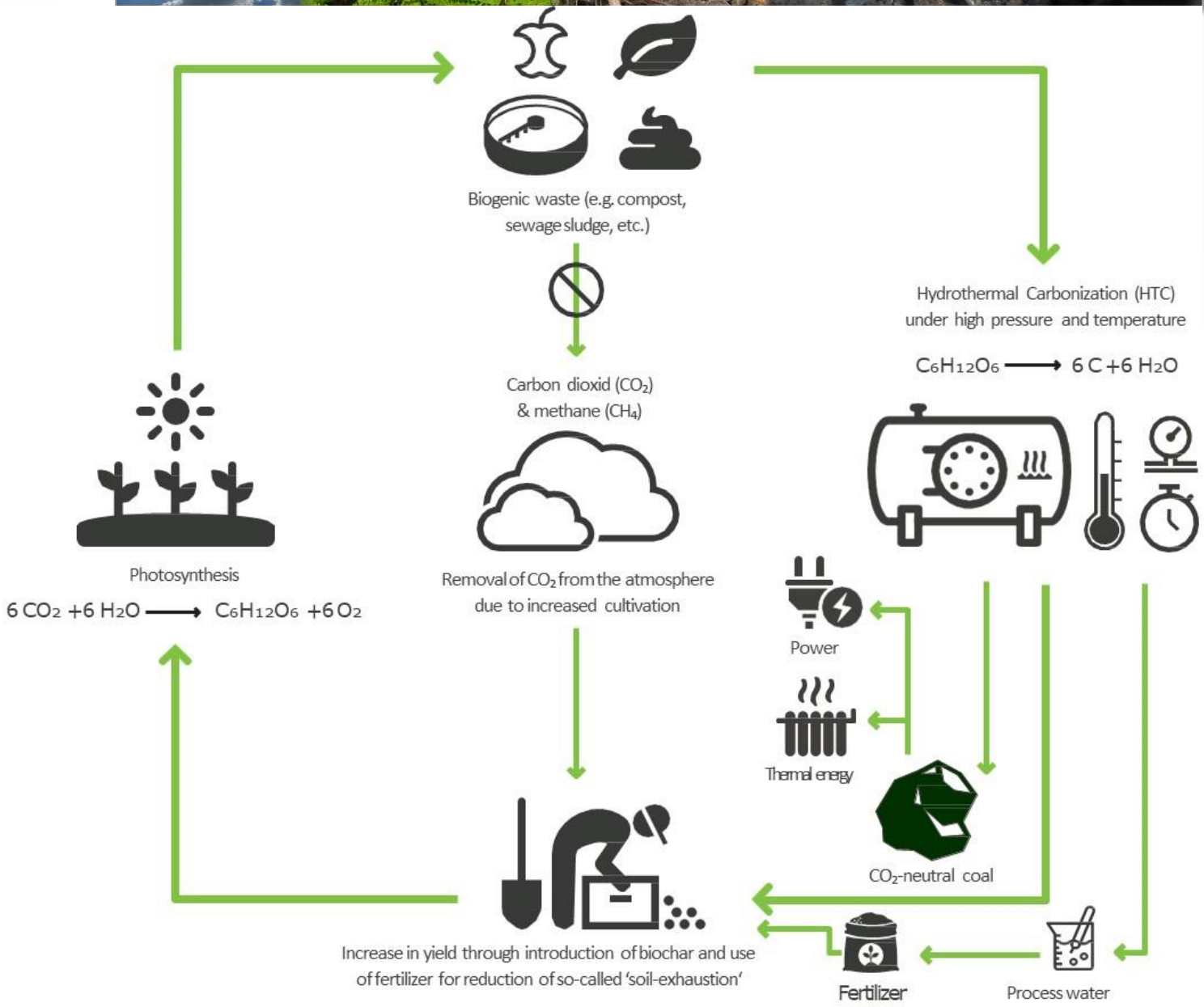
Carbon efficiency = 100%

(6 C + 6 H_2O)

Coal

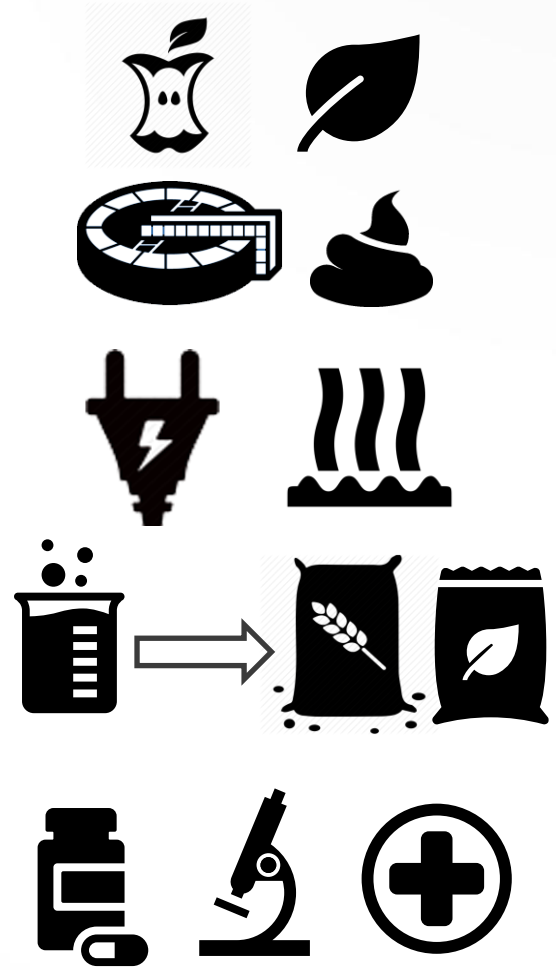
Closed substance cycle waste management by GRENOL

- CO_2 neutral energy
- Tradable residual materials
  - Nutrients back to the soil
  - CO_2 - sink via inert biocoal
  - Closing the CO_2 – cycle
  - Closing the mineral - cycle
  - Closing the water - cycle



What are the benefits of HTC / VTC Technology?

- Any kind of **wet** and **dry** biomass can be used, also as **mixture**.
- The coal is **CO_2-neutral**, **storable** and has a **high energy content** (up to 23 MJ/kg).
- **$^2/_3$ of the energy** from the biomass is **conserved** within the coal and can be used in wood gasifier to produce syngas in combination with a CHP to produce **energy and heat at the same time**.
- The process water can be used for a concentrated **fertilizer** or to **boost methane production** in fermentation plants or direct without any treatment for **irrigation**.
- **Disinfection** of the input material, destroying of pathogens, antibiotics, hormone, pesticides and even microplastic.
- **Easy handling** of the plant, **space saving** and **decentral** technology solution.



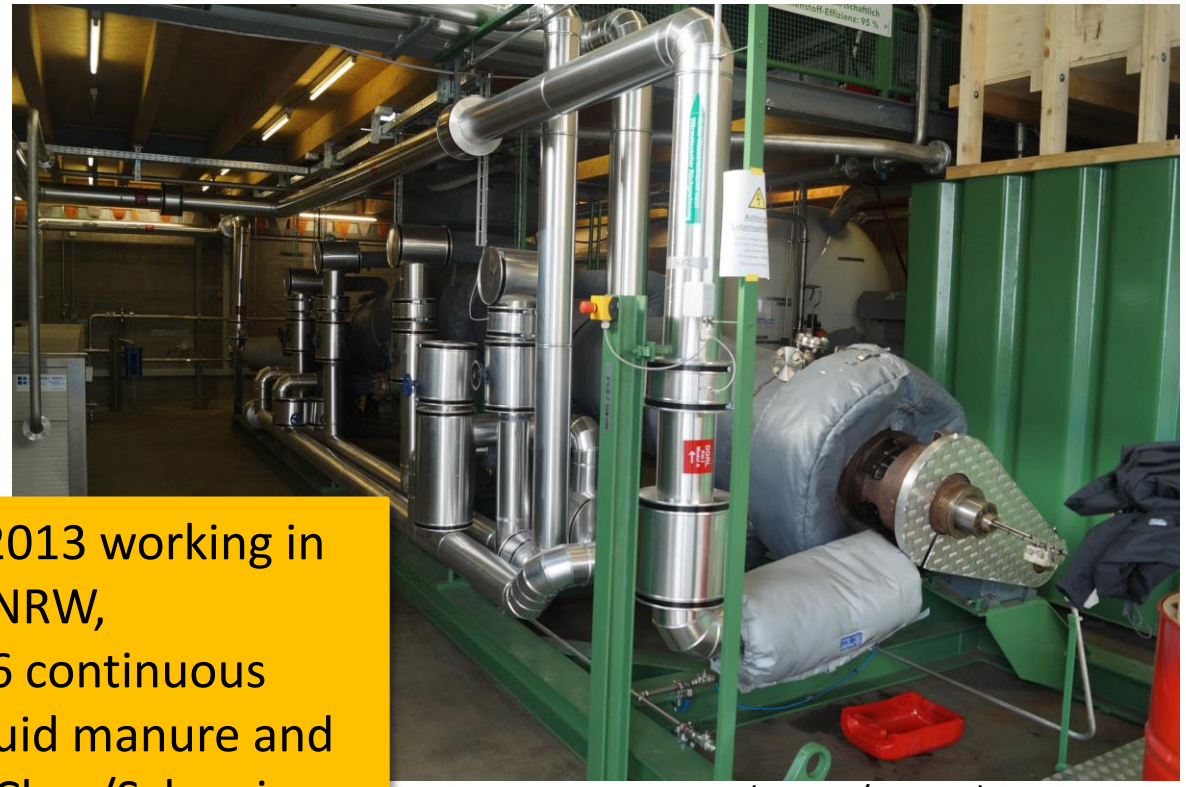
HTC-Base Module – Converts your poo into coal

Tube reactor type (14.000t/a Input) 2019-now

- continuous system (24/7)
- **< 30 %** dry matter content

Since December 2013 working in Kalkar/NRW,
since Dec. 2016 continuous operation with liquid manure and sewage sludge, Chur/Schweiz

Input capacity:
15 t/d biomass
with ca. **5-30 %** dry matter content



Screw reactor type (5.000t/a Input) 2013-2019

- for **liquid** organic waste
- sewage sludge, liquid cow & swine manure, biogas-digester etc.

VTC-plant is a technology for dirty jobs with lumpy material

VTC-Batch system

- Batch-system, discontinuous
- **> 30 %** dry matter content
- no problem with impurity materials
- usable for **solid, lumpy materials**
- for example: the municipal organic waste bin, green waste, solid manure, composte etc.
- Running in China with food waste

Municipal organic waste incl. plastic

Coal yield after carbonisation

The GRENOL concept and its possibilities

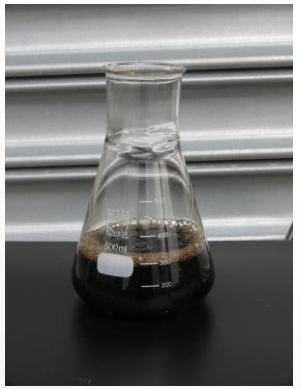
Organic waste

HTC-Reactor (< 30% DM) or VTC-Reactor (> 30% DM)

Coal/Water Separation

HTC/VTC Biocoal

+



Process Water

Step 1

The GRENOL concept and its possibilities

HTC/VTC Biocoal

Drying/Briquetting

Biocoal-sale

Entrained flow carburetor

Wood / Coal Gasifiers

+ CHP

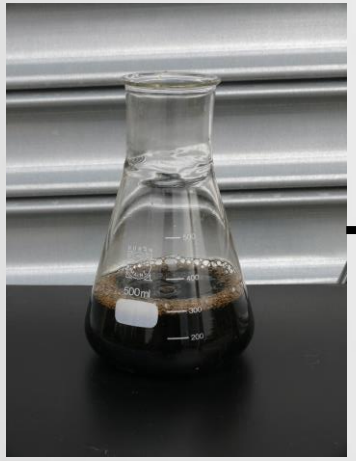
Electricity & Heat

Activated carbon

Step 2

Hydrogen (H_2)

The GRENOL concept and its possibilities



Process Water

Fertilizer production

Fertilizer sale

Distilled water

Methane Booster

Greenhouse solution

Step 3

How you can make money with Digestate? – an example

Biogas digestate

100 MWh/a Energy

600 MWh/a Heat

750t/a Bio-Coal

Gasifier

~ 1.240 MWh/a Energy

~ 2.500 MWh/a Heat

~ 5.000 t/a Biogas digestate with 22-27 % dry matter

HTC-Reactor

- **Earnings** from the disposal up to **10-25 Euro/t** manure in Europe
- **Hygienisation** of the input material
- **Easy handling**

Biogas plant

or

Back into the digester tower to **optimize** the **methane** production

or

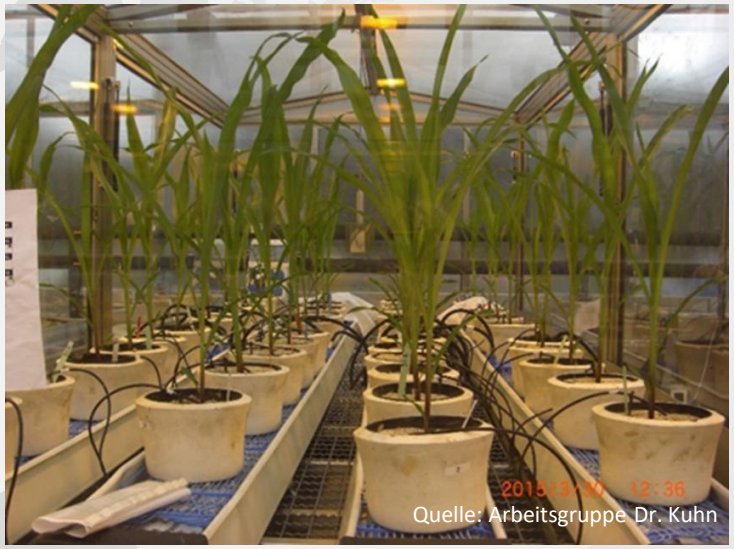
Process water

~ 340t/a N,P,K-Fertilizer

Further advantages:
Biochar from digestate, as soil optimizer on barren soils

In long-term cooperation with Dr. A. Kuhn (IBG-2: Plant Sciences, FZ Jülich), many agricultural studies have been carried out in recent years.

- Comparisons with different soil optimizers (hydrochar & pyrochar) with/without fertilizer use.
- Comparisons with different plant species (corn, lettuce, strawberries and carrot plants).
- Analyses of eco-physiological soil and plant parameters.


Quelle: Arbeitsgruppe Dr. Kuhn


Quelle: Arbeitsgruppe Dr. Kuhn

Conclusion

The GRENOL HTC / VTC-procedures are new alternative methods to process organic waste in an environmentally friendly manner, and to close the cycle of nutrients and the carbon cycle in waste management.

The GRENOL HTC / VTC-technologies offer a very convenient and cost-saving method for processing of any organic waste material and at the same time the possibility to achieve CO_2-certificates.

The GRENOL HTC / VTC reactor is the key element of GRENOL's integral concept for the decentral production of electrical and thermal energy, as well as activated carbon, Hydrogen and different fertilizers.

Thank you for your attention!

For further detailed information, planning and calculation studies, please contact us via phone or E-mail at info@GRENOL.de

National Energy Globe Award Germany 2016
1st place

Energy Globe
The world award for sustainability

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