WABIO® Technologie GmbH

New Biogas Generation Technology : Utilizing All Fibrous/Organic Solid and Liquid Wastes

WABIO Technologie GmbH…

- Established in 1990 in Gera, East Germany
  - ➢ More than 25 Years of R&D is the basis of WABIO Technology
- Proprietary and Patented Methane Fermentation process from Biogas
  - ➢ Use of Waste Lignocellulosic Material such as Rice Husk, Rice Straw, Wheat Straw, Sugar Mill Pressmud, Distillery Spent Wash, Brewery Spent Grain, Food Waste, **MSW organic fraction**, Empty Fruit Bunches (EFBs) etc.
- Several Reference Plants in operation

4.1 MW Capacity since 2007

800 KW Capacity since 1997

11,25 MW Capacity
Commissioning 2014
East Kalimanatan

30 MWth China 2019

More than 20 years operating experience

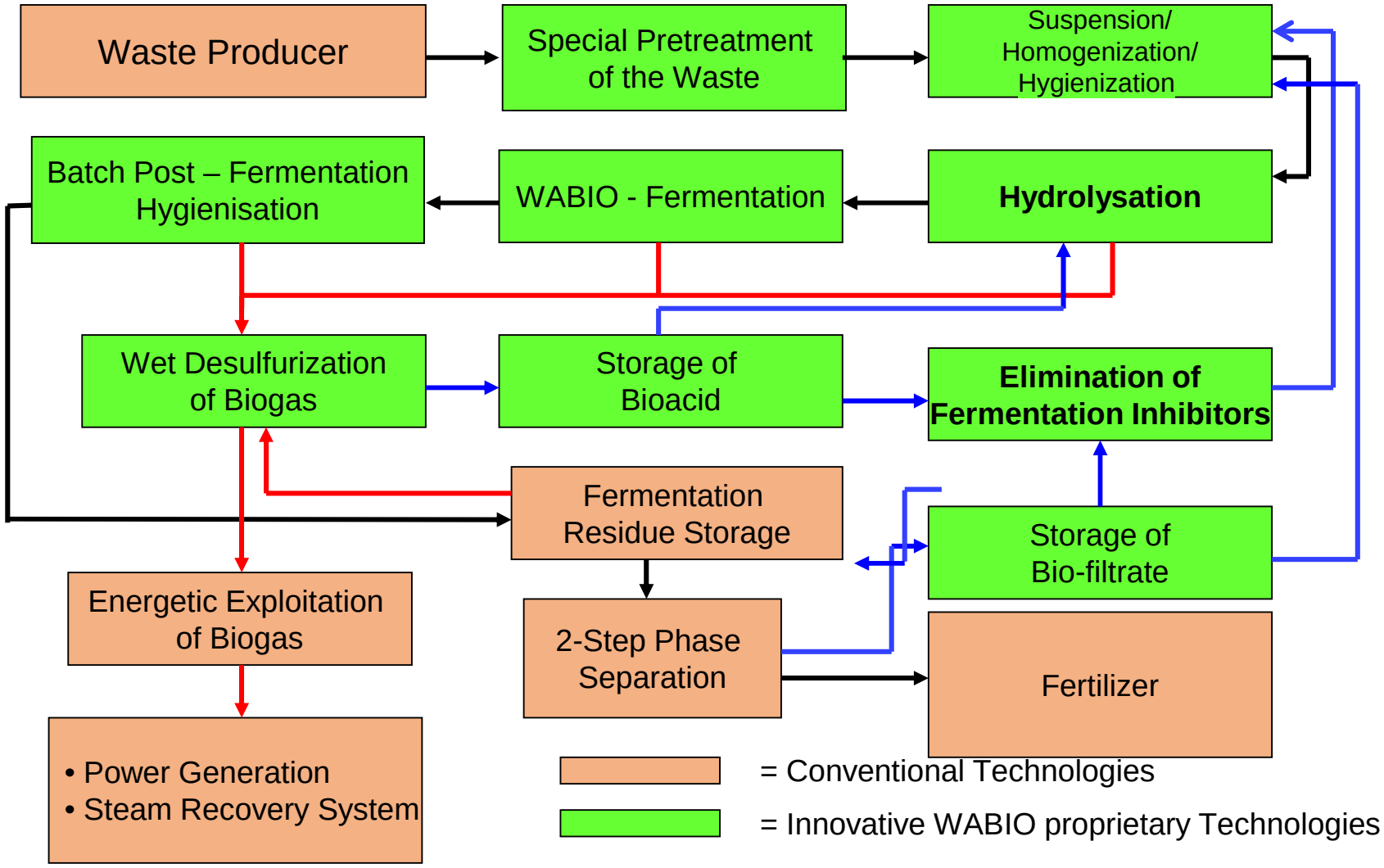
- Owning and operating the first industrial sized waste to energy Biogas plant in Germany from 1997 onwards – 2,8 MW th. – using also MSW from the city of Zwickau for 2 years.

- Owning and operating thee worlds first biogas biorefinery at 12 MW th. using mixed waste inputs, spent wash and husk – now using household and commercial food waste from 2006 to 2008

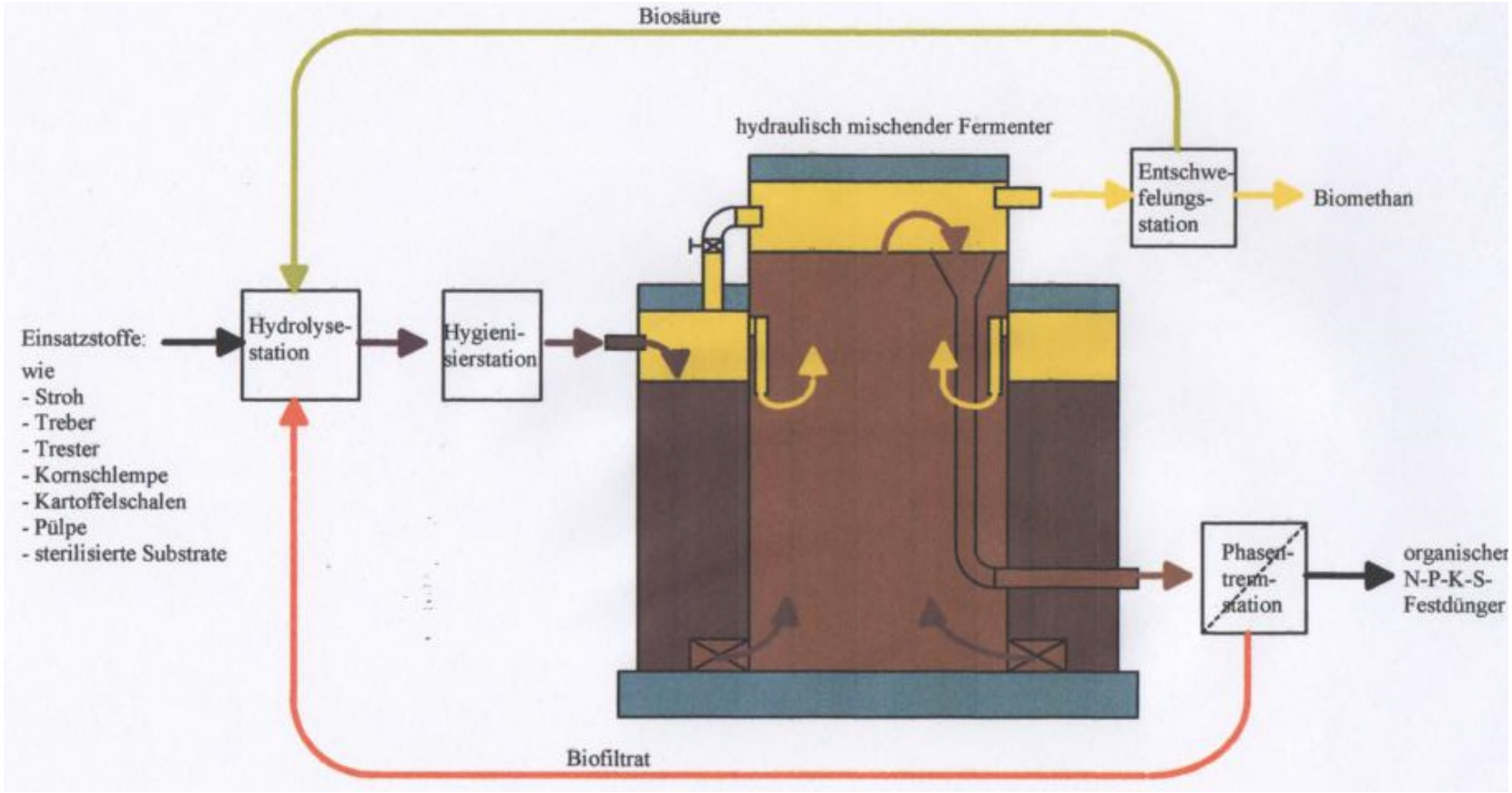
- Operating worlds first solid palm waste biogas plant at 12 MW th. in Kalimantan starting with successful commissioning in December 2014

- Operating a German biogas plant 11 MW th. to prepare for upgrade for about one year.

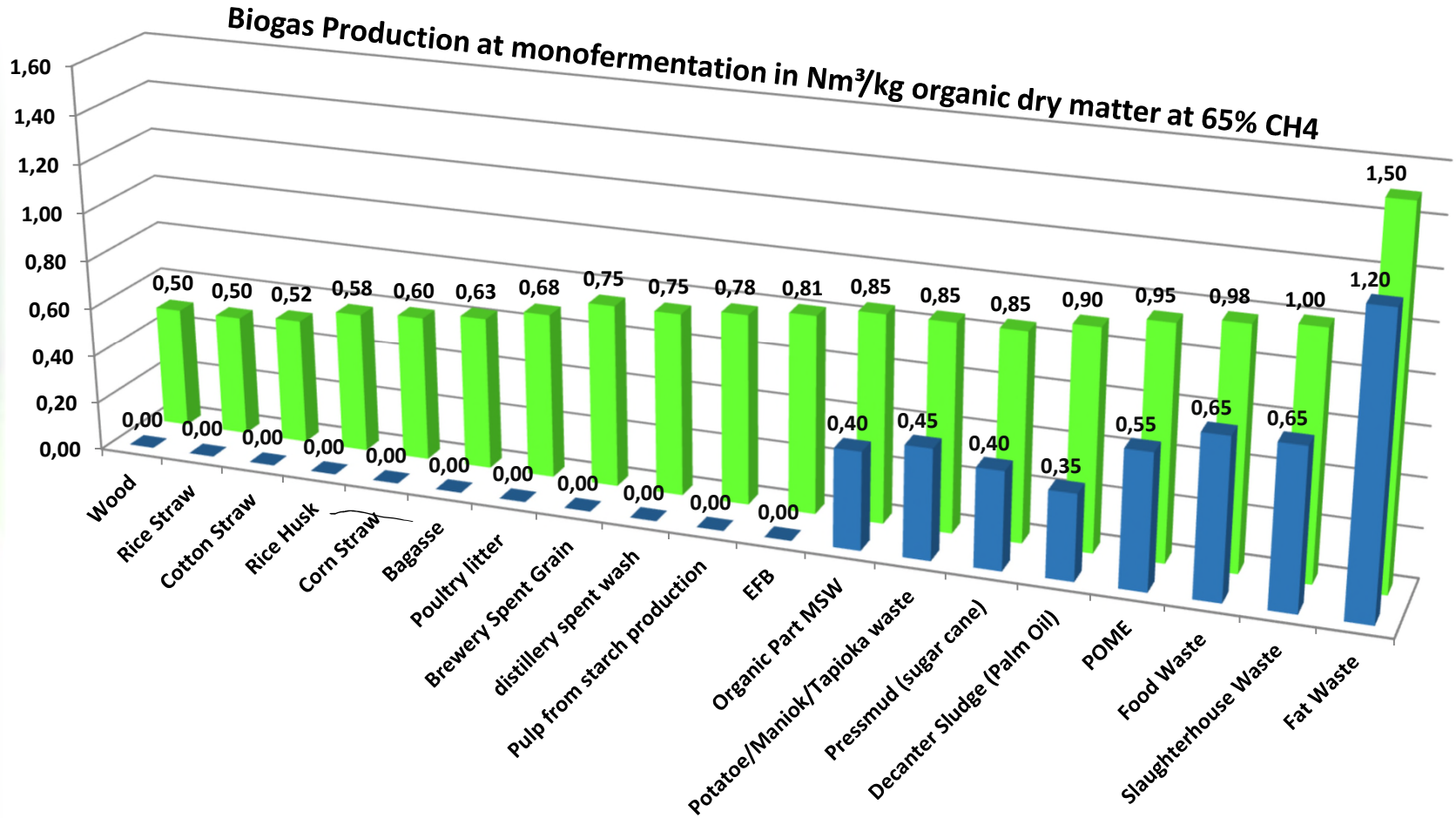
WABIO Bio-Methanation Process



WABIO process is the basis for maximum efficiency



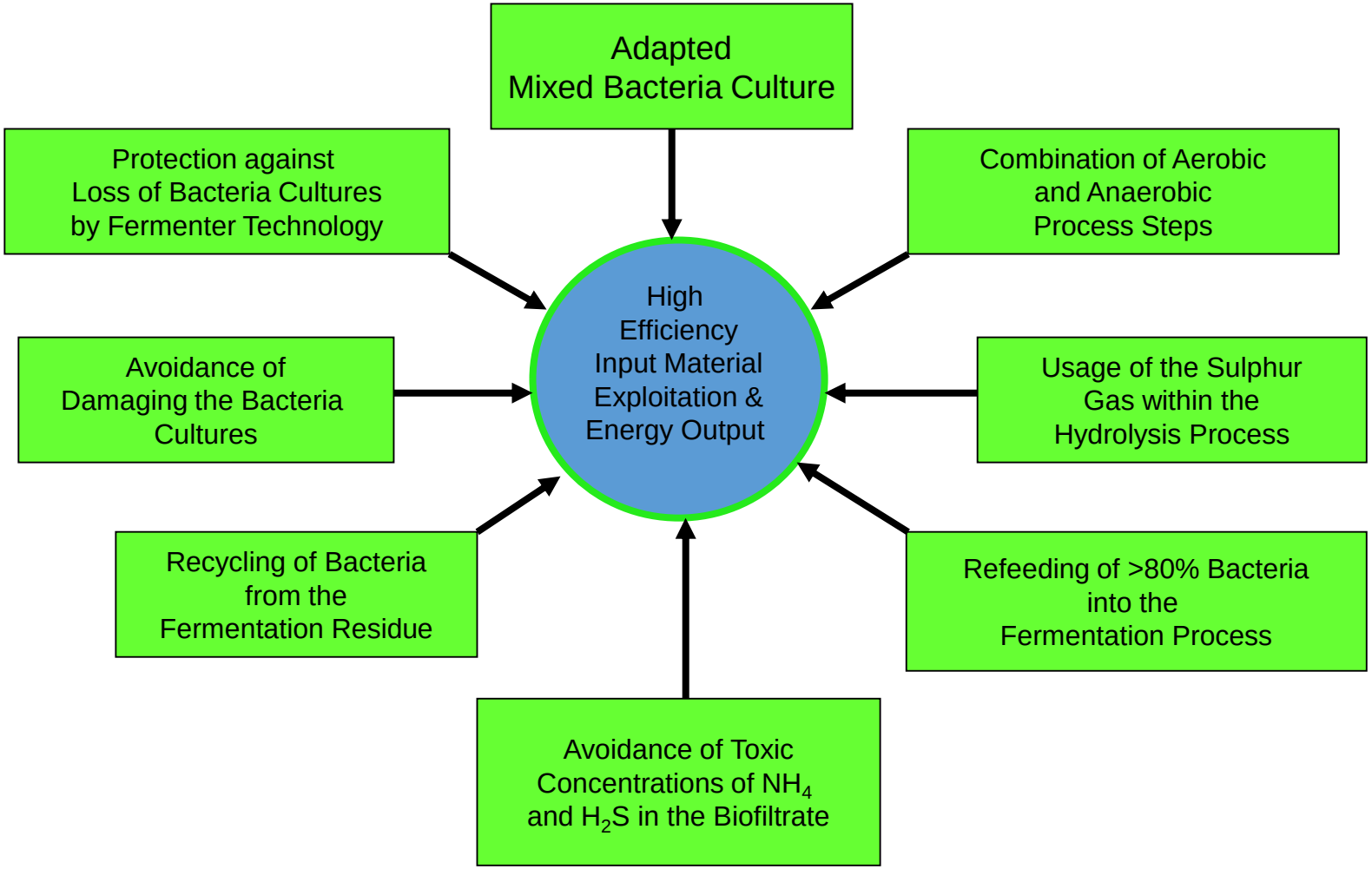
Comparison on WABIO Biogas yield to conventional Biogas yield



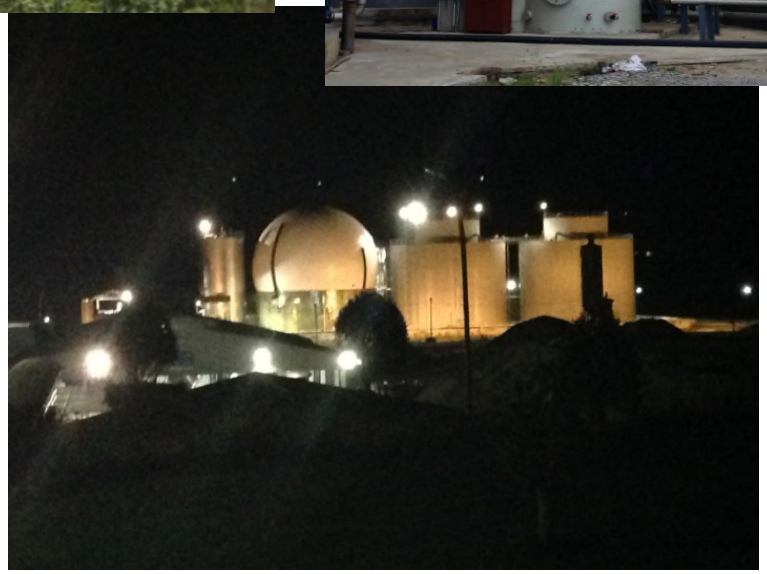
- WABIO produce more biogas for the same input, compared to the standard method
- WABIO is proven to process more variations of organic dry matter

- Data as of March 2018

Features of WABIO Ligno-cellulosic Methanation



WABIO Technologie GmbH…



WABIO Technologie GmbH…

The WABIO Retrofit-Solution:

FOOD CROP AND ENERGY

The WABIO Straw solution for a 0,5 MWel Biogas plant

WABIO design

- Classical biogas plant 0,5 MWel. is being built according to WABIO concept and design

New Feedstock

- The plant feedstock is not crop, food, feedstock or manure, **but only** → **Cornstraw,** **alternatively any other straw**

Result

- Instead of 10.000 t corn silage and 4.500 t manure p.a. **only**

↓

3.500 t p.a. dry Cornstraw

Profitability of WABIO solution per ha of land

For Agricultural Companies:

Actual:
Agricultural companies sell now from 1 ha corn cobs of maybe 9 t at some 130-150 EUR/t

Revenue per ha (at 8 t): EUR 1.170,00 – 1.350,00

Chances with WABIO:
Now agricultural companies can generate biogas from all the waste straw normally left on the field. This gives double income from one source.

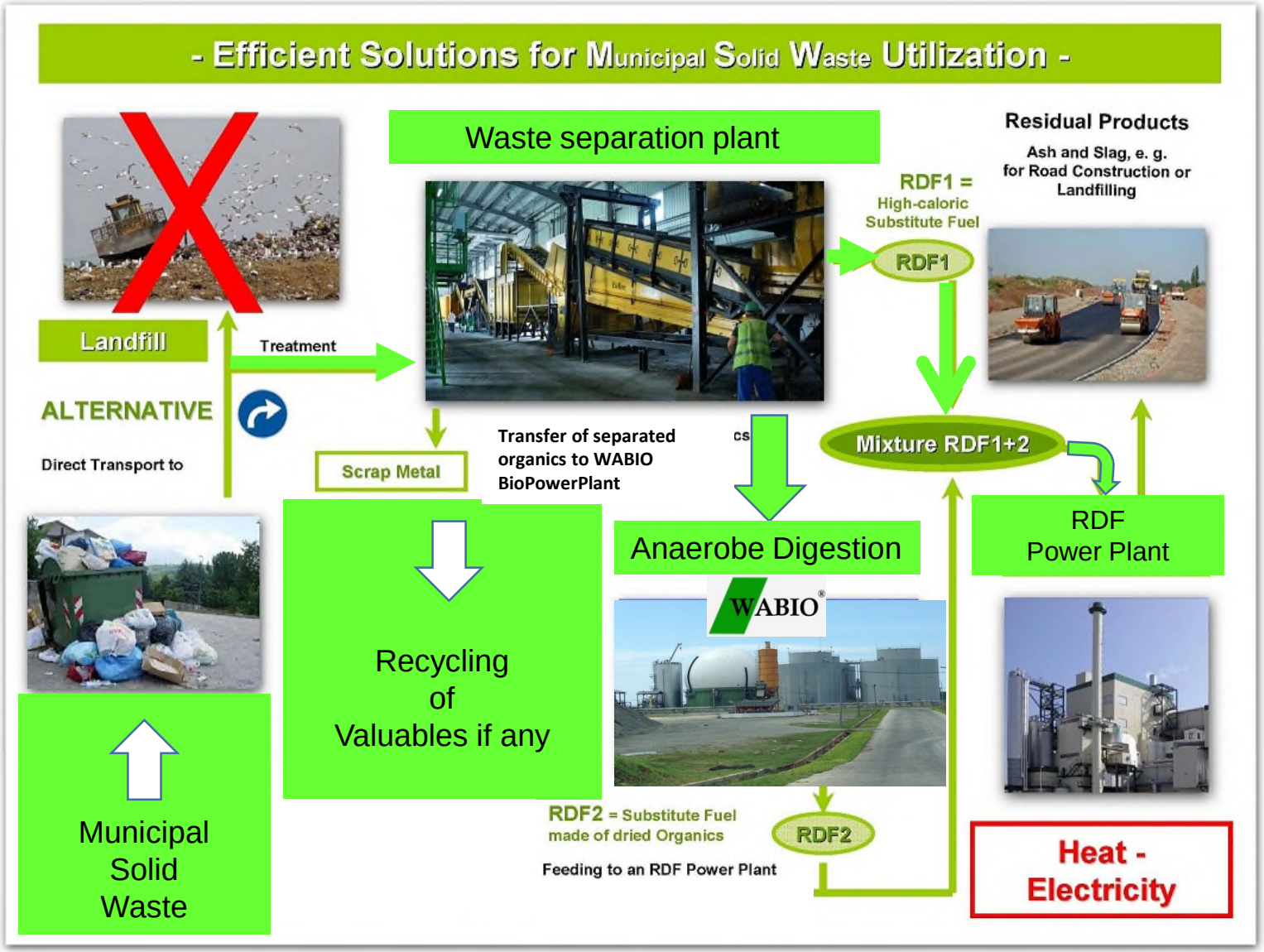
After harvest 1 ha gives apx. 8-9 t of straw for use. Used in WABIO system it can generate apx. 9.000 kWh el..

Additional revenue per ha from 9.000 kWh el. at e.g. 13,00 EURCents/kWh el.: EUR 1.170,00

Total revenue per ha with WABIO: 2.520,00 compared to EUR 1.350,00 (minus waste straw disposal)
Additionally apx. 250 € in savings of fertilizer, so

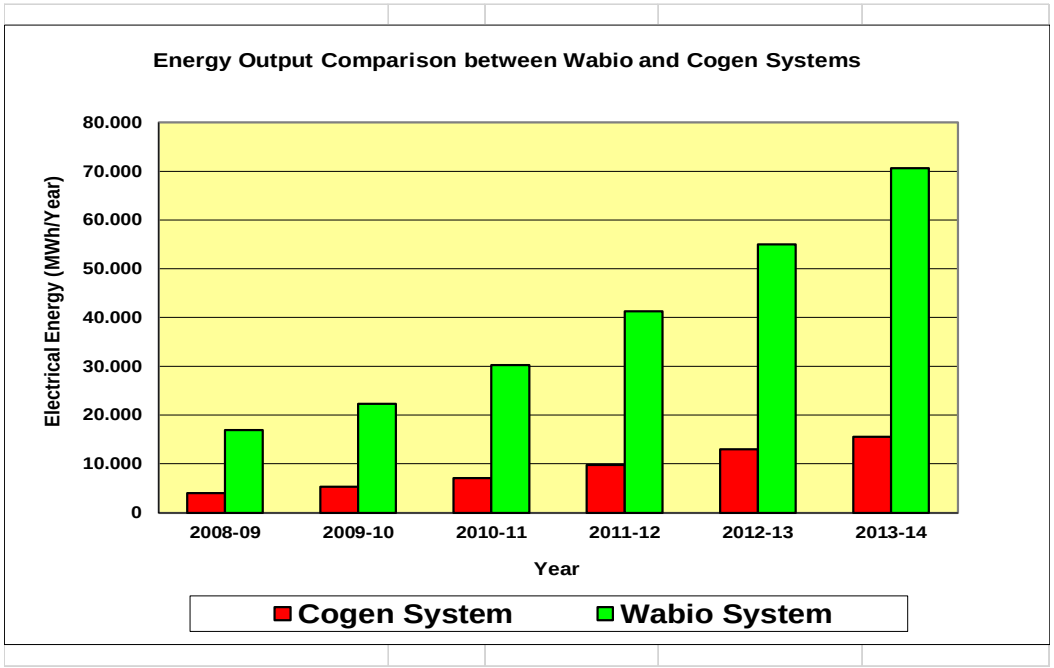
Total value using WABIO per ha:
EUR 2.770,00 EUR (at €C 13/kWhel) compared to EUR 1.350,00 (minus straw disposal)!

MSW Concept WABIO



Comparison between Wabio & Cogen Technology

- Low Energy Output for Cogen system:
  - For Identical Input Volumes of MSW **organic** Waste input, the Energy Output from the Wabio system is apx. 4 times that of a Cogen system
  - Average organic waste has high moisture of 75 - 80% requiring mechanical drying prior to using as fuel in Boilers



- Environmental Pollution
  - Emission concerns arising from burning Waste

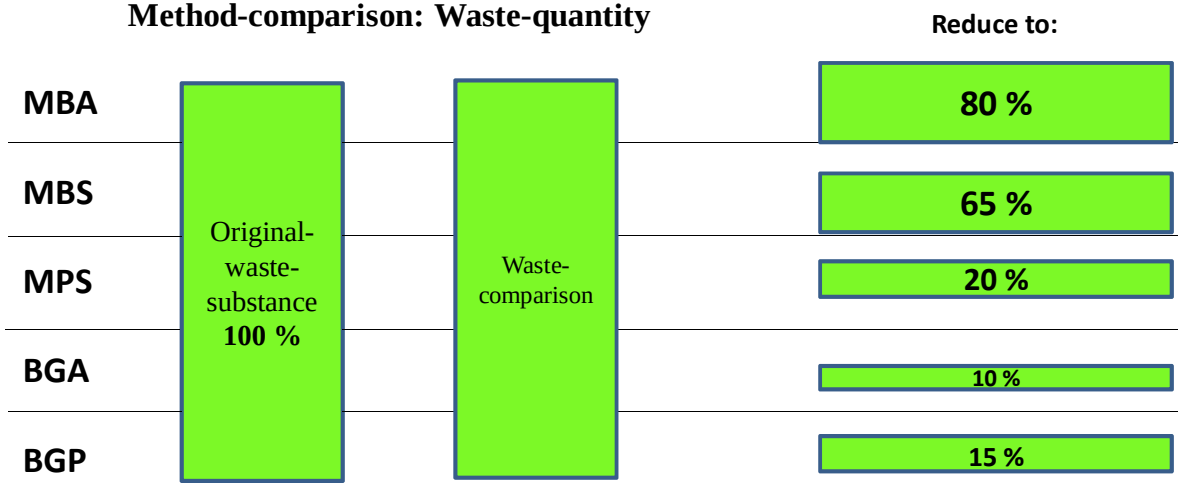
- No residue:
  - All residue from the Wabio process fed to RDF-plant for additional energy and ZERO Waste concept
  - Remaining small amounts of Ash from Combustion can be disposed to road construction or other purposes – some make fertilizer or recover nutrients

Data as of March 2018

Waste reduction

WABIO Technologie GmbH - R & D Center Neukirchen
D-08459 Neukirchen/Pleiße
Project: MSW organic-waste treatment

Method-comparison: Waste-quantity

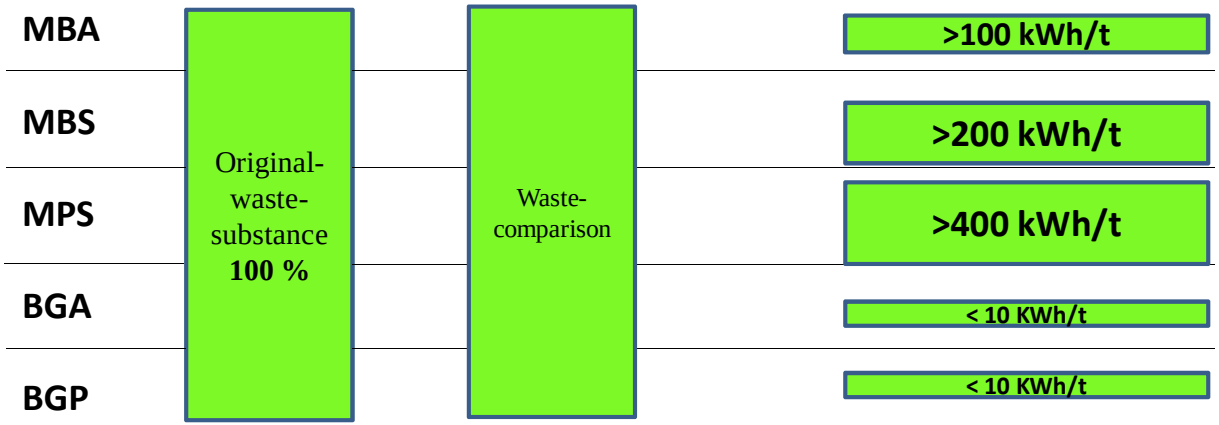


Legend:
MBA = Mechanical-biological comparison
MBS = Mechanical-biological stabilize
MPS = Mechanical-physical stabilize
BGA = Biogas powerplant comparison
BGP = Biogas-pyrolysis comparison

Energy consumption

WABIO Technologie GmbH - R & D Center Neukirchen
D-08459 Neukirchen/Pleiße
Project: MSW organic-waste treatment

Method-comparison: Energy-Consumption

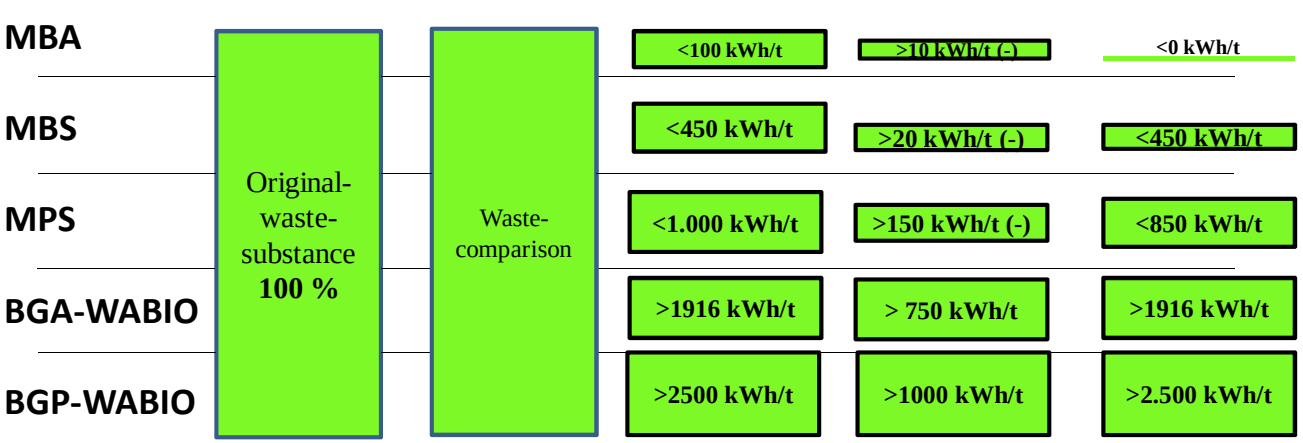


Legend:
MBA = Mechanical-biological comparison
MBS = Mechanical-biological stabilize
MPS = Mechanical-physical stabilize
BGA = Biogas powerplant comparison
BGP = Biogas-pyrolysis comparison

Energy Production

WABIO Technologie GmbH - R & D Center Neukirchen
D-08459 Neukirchen/Pleiße
Project: MSW organic waste treatment

Method-comparison by: Energy-production



Legend:
MBA = Mechanical-biological comparison
MBS = Mechanical-biological stabilize
MPS = Mechanical-physical stabilize
BGA = Biogas powerplant comparison
BGP = Biogas-pyrolysis comparison

MSW – WABIO Key Facts for a 1000t/d input

- **Traditional Solution**:
  - Full Combustion, depending on input mix and technology: apx. 18-21 MWel
  - Environmental unfriendly solution

- **WABIO Solution**:
  - Separation of wet waste (organics) and dry waste (recyclables, metal, electronics, stones, light plastics, combustables by EuRec
  - Depending on input mix for wet waste at 60% organics WABIO generates apx.
    - 194.400 m³ of Biogas at avg. 65% CH4
    - Total CV of 1,263,600 kWh per day
    - Apx. 30 MWel using max. combined cycle
  - Combustion plant generates from the dry waste apx. 14-15 MWel. using high end steam turbines
  - Environmental friendly solution

- Total Power generation of **apx. 45 MWel** for 1000 t/d MSW at 8000 hours rated capacity possible.

Data as of March 2018

MSW – WABIO Key Facts for a 1000t/d input

- **WABIO** combined MSW-Treatment is now profitable business:
  - Feed in tariff for power
  - Such plant will have fast return of investment
- **Competitors** need Tipping fees for the waste to be able to be profitable
  - almost no operating profits
  - regularly 8-10 years return of investment including tipping fees

WABIO Technologie GmbH… Roding waste

Fertilizer

Reception

reception tank

Comparison between Wabio & other biogas technologies

- WABIO is worldwide the only biogas system to digest Ligno-Cellulose very effectively and by monofermentation. The Biogas-Output for e.g. corn-straw is minimum apx. 0,6 m³ Biogas/kg organic dry mass.
- WABIO has the only Biogas system in the world to digest pure meat/fish/and other protein rich waste (chicken waste) by mono fermentation – it handles the ammonium concentrations by a special process which also enriches the fertilizer.
- WABIO is able to use any organic input which can be changed as often as wished by quantity and quality.
- WABIO has superior biogas yields on any input material leading to a very interesting Return on Investment (ROI).
- WABIO‘s technology is specially designed for Inputs like (rice-/wheat-/corn-) straw or husk, tree cut, palm waste, tobacco plant waste, coconut shells, bagasse, vinasse, sugar production waste, distillers spent grain, sewage sludge, protein rich meat or fish waste, any type of food production waste, paper sludge of the paper industry (cellulose), organic fraction of MSW.

Thank You!