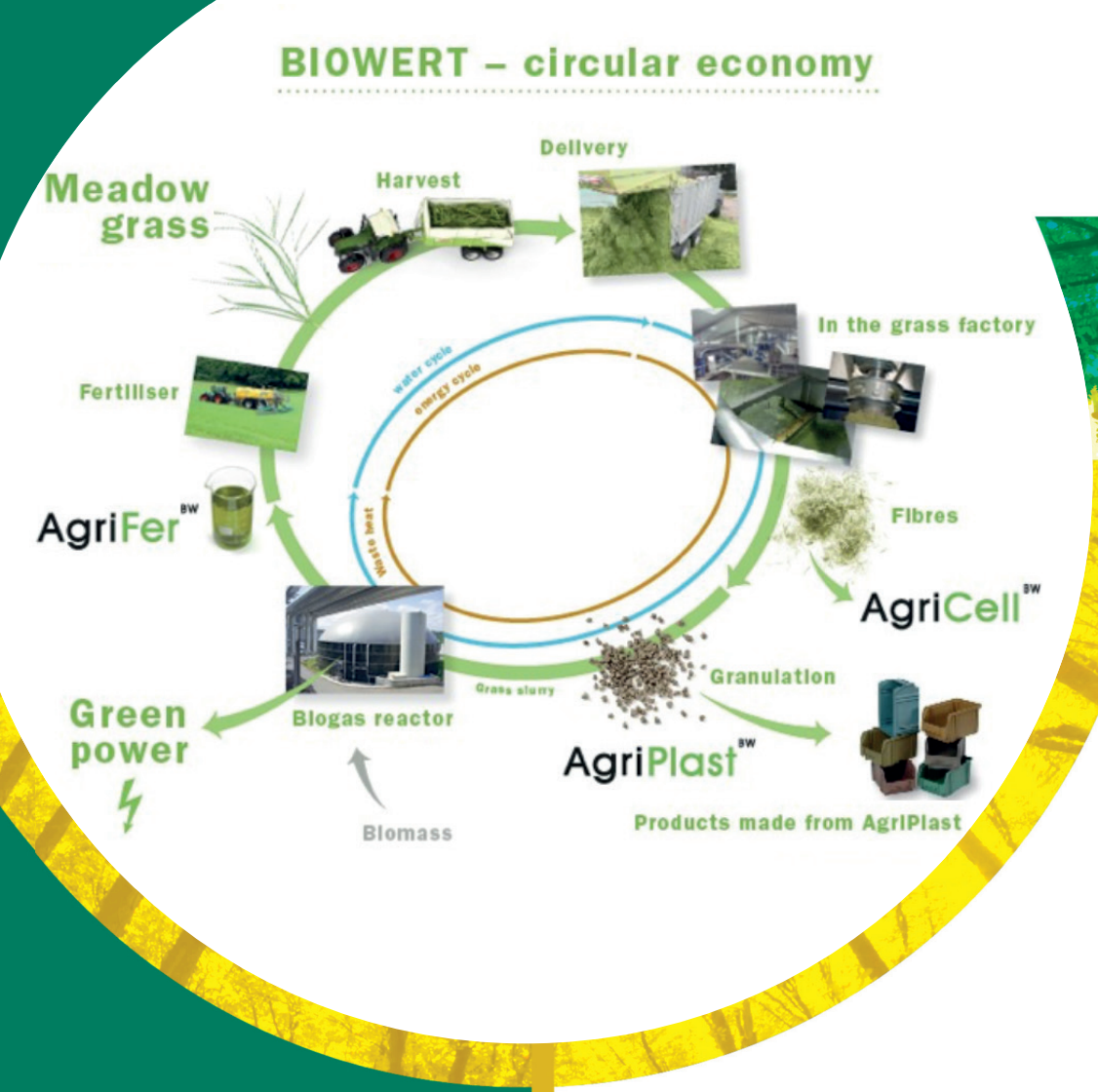
BIOGAS IN SOCIETY
A Case Story

BIOWERT GRASS BIOREFINERY

BIOBASED PLASTICS, GERMANY



IEA Bioenergy Task 37

IEA Bioenergy: Task 37: June 2019

PLANT CONCEPT AND FRAMEWORK CONDITIONS

We live in a world with significant concerns related to climate change and an associated need to reduce significantly use of fossil resources; this necessitates supply of energy and products from renewable sustainable resources. The principle of biorefineries is resource-efficient utilisation of bio-based raw materials. Based on this concept, the Biowert Industrie GmbH was founded by Michael Gass in 2000 as a Swiss-German company. The first Biowert grass refinery started operation in 2007 and is located in Brensbach, Germany, on an 18,000 m^2 site (Figure 1).

The main products based on grass from permanent pastureland and arable land for crop production are grass fibre insulation (AgriCell^{BW}), natural fibre reinforced plastic (AgriPlast^{BW}, Figure 2) and fertiliser made from digestate (AgriFer^{BW}). The facility has an annual throughput of about 2,000 t dry matter (equivalent to 8,000 t grass per year at 25%–30% dry matter content). The integrated biogas plant produces c. 1,340,000 m^3 of biogas annually which is used in combined heat and power facilities, which in 2012 produced 5.2 GWh_{el} of electricity.

The Biowert cycle is shown in Figure 3. Grass is stored within bunker silos, where the ensiling process takes place. The first step after ensiling includes mechanical treatment of grass silage and isolation of grass fibres through pulping, drying and pressing processes. The grass fibres are further processed into AgriCell^{BW} and AgriPlast^{BW} synthetic granules. AgriPlast^{BM} contains 30 – 50% grass fibres and 50–70% recycled polyolefine and is used for injection moulding for a range of uses (Figure 2).

The grass juice remaining from mechanical pretreatment of grass silage is used as substrate in the biogas plant (together with local co-substrates such as food waste and slurry). The heat and electricity derived from the biogas facility is used to satisfy the energy in the biorefinery and excess electricity is exported to the electricity grid. Wastewater arising from the process is reused for pretreatment (slurrying) of grass silage. Digestate from the biogas plant is further processed to a concentrated and a liquid biofertilizer (AgriFer^{BW}) used by local farmers. This closes the nutrient cycle in the circular economy.

Figure 1: Biowert grass refinery located in Brensbach, Germany

Figure 2: AgriPlast^{BW} products

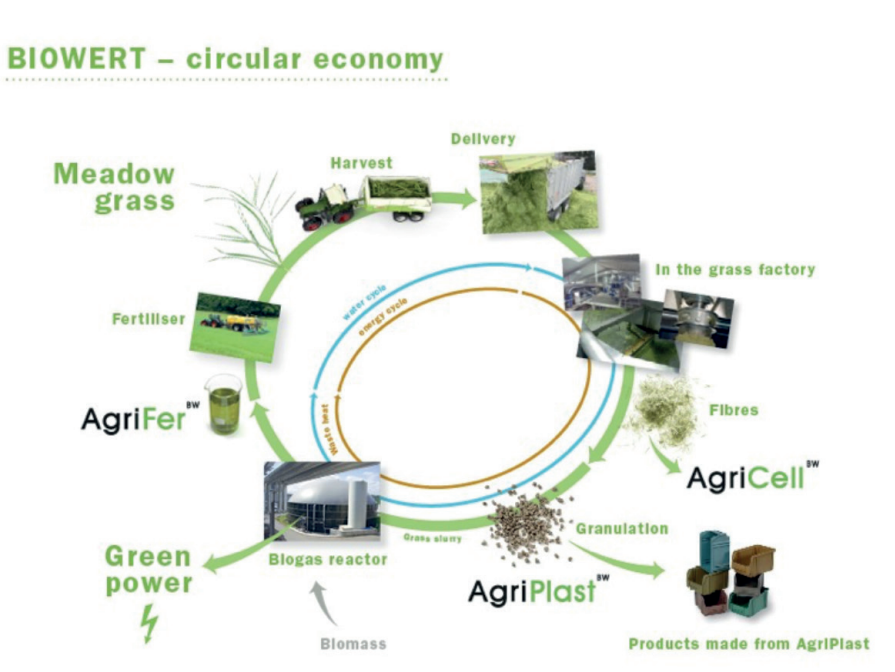


Figure 3: The Biowert Cycle

PROCESS DATA

The process combines production of bio-based materials within the grass biorefinery and a biogas CHP plant (Table 1). Grass juice and other biogenic residual materials (such as local food waste) are used for biogas production.

ECONOMIC AND ECOLOGIC ASPECTS

Relatively high sale prices of material products (AgriPlast^{BW} and AgriCell^{BW}) as well as the integration of two product options (insulation or bioplastic) allows flexibility to market changes. These are key factors for successful concept implementation. Rising electricity prices make future energy use from the biorefinery-associated biogas plant even more attractive. Table 2 summaries the environmental evaluation of the grass biorefinery.

Table 1: Input and output of the grass refinery and its associated biogas and CHP plant (Brensbach, Germany)
***data based on 2007 – 2012 period**

	Grass refinery	Biogas & CHP plant
Input		
Biomass	8,000 t / year	Grass juice: 1,942 t / year Co-substrates in biogas facility: 15,260 t / year
Electricity demand	2.5 – 3 GWh_{el} / year	
Output		
Product	AgriCell^{BW}: 1,410 t / year AgriPlast^{BW}: 2,500 t / year	Biogas: Approximately 1,340,000 m³ / year at methane concentration of 60 % AgriFer^{BW} concentrated and AgriFer^{BW} liquid digestate: 11,362 t / year
Electricity production		5.2 GWh_{el} in 2012

OUTLOOK

The utilisation of grass for energy and raw material production is an example of the bioeconomy connecting agriculture and industry; such models provide for future expansion and diversification in the agricultural sector. The vision for the Biowert grass biorefinery is to develop two further grass refineries within the next three to five years.

Table 2: Environmental Evaluation of the grass refinery

Environmental evaluation:
· 5 GWh_{el} / year renewable energy production
· 100 % recyclable products
· Ecological footprint reduction (lower ecotoxicity compared to petrol-based plastics)
· Process water recycling
· Lower transport costs (local sources)

IEA Bioenergy task 37
"Energy from Biogas"
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IEA BIOENERGY

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