STUDY TOUR
BIOFERTILISER PRODUCTION PLANTS

28.August – 08. September 2023

Deutsches Biomasseforschungszentrum gemeinnützige GmbH
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Content

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Participants:

University of Jimma	Dr. Abebe Nigussie NIGATU Dr. Milkiyas Ahmed YASIN Dr. Gebeyanesh Worku ZERSSA Mr. Shewangizaw Werkagenehu DEMISSIE
IQQO	Mr. Tilahun Abera ISHETE Mr. Getachew Hailu WENDIMAGEGNO

ETH-Soil Implementing Consortium in Oromia, Ethiopia

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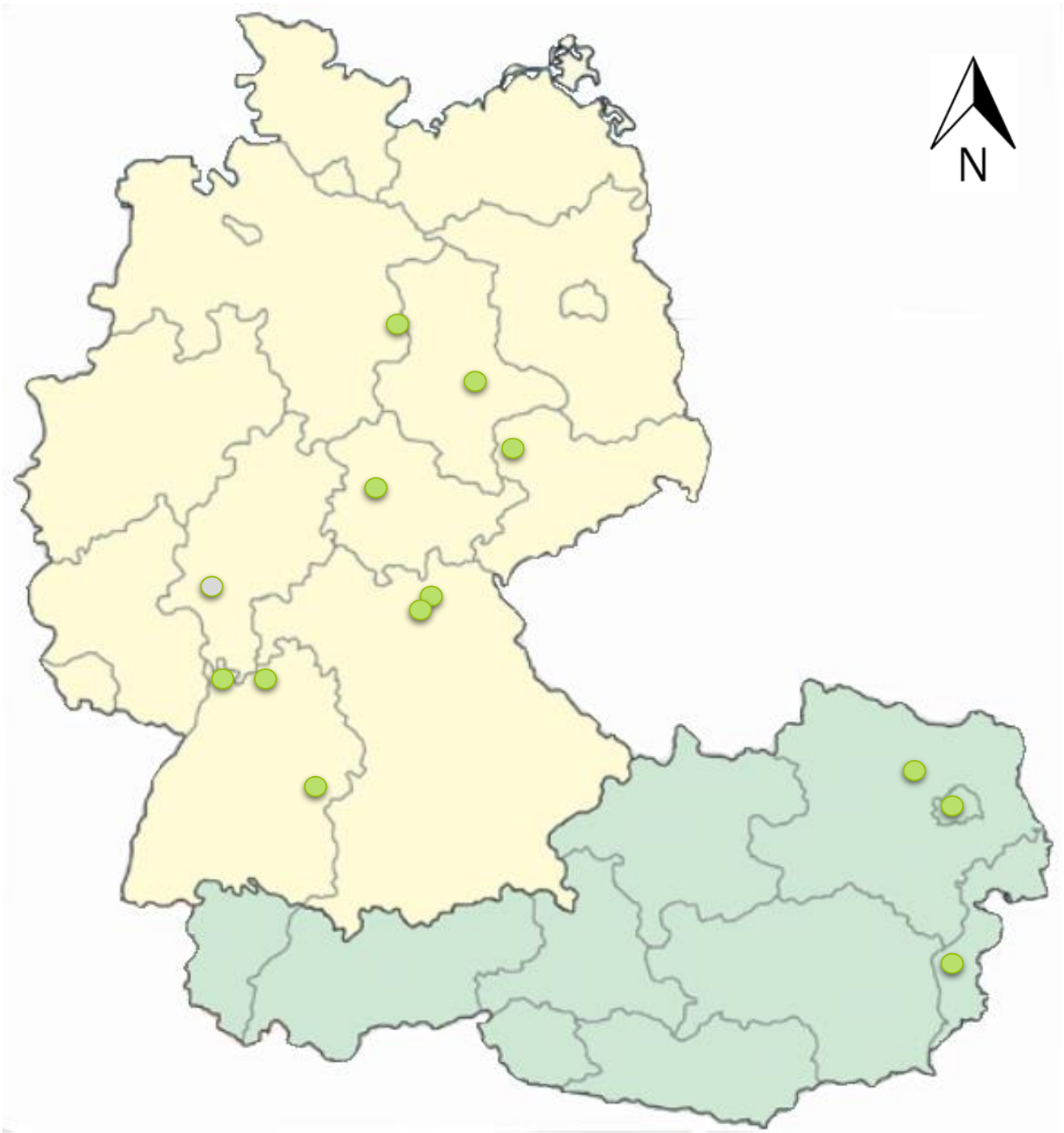
OVERVIEW TOUR

View on google Maps



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The study tour was organised & accompanied by:

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Study on Tour - Introduction

We were very pleased to welcome you and present this 12-day study tour through Germany and Austria. In this trip we included different commercial players in compost and biochar production. We visited companies specialized at one part of the process chain, for example biochar production, as well as such that take care of the whole value chain from the pyrolysis of residues to finished biofertilizer.

On our journey we learned about different processes and technologies around pyrolysis and composting. The goal of the trip was to find the optimal items and technique for the plant at Jimma University, the substrate composition and dimension of the plant, as well as suitable for the climatic conditions in Ethiopia.

In order to consider different approaches, we also visited a biogas plant that applies plant carbon in the digester. We also took a closer look at vermicompost and visited two companies that produce and market vermicompost.

On the next pages you find a detailed description for every location we visited. Further material can be found here: https://edms.dbfz.de/seafile/d/06b546efde62413cb6d7/

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DAY 1 (28TH AUGUST 2023)

Time	Goal and Aim	Transport	Address / Person in Charge
02:00 PM	Welcome & Introduction (Volker, Kerstin, Uta, Sophia) *		**DBFZ Room 1.108** Dr. Volker Lenz – Head of Department Thermo-chemical Conversion Kerstin Wilde – Project Manager Uta Schmieder, Sophia Bothe – Department Bioenergy Systems
02:30 PM	Presentation "Low emission process design of a composting plant" *		Julian Matlach, Department Biochemical Conversion, DBFZ
03:00 PM	Presentation on pyrolysis and biochar production at DBFZ*		Dr. Dennis Krüger, Department Thermo-chemical Conversion
04:00 PM	Coffee break, organisational matters, group photograph		

04:30 PM	Visit and guided tour of the institute grounds, especially biogas plant (stirred tank fermenter), biogas lab*		Markus Lenhart, Dr. Marcel Pohl, Department Biochemical Conversion, DBFZ
05:30 PM	Transfer to Leipzig city center and joint dinner from 6:30 pm	tram	GAO Vegan Restaurant, Zentralstraße 1 (corner to Gottschedstraße), 04109 Leipzig

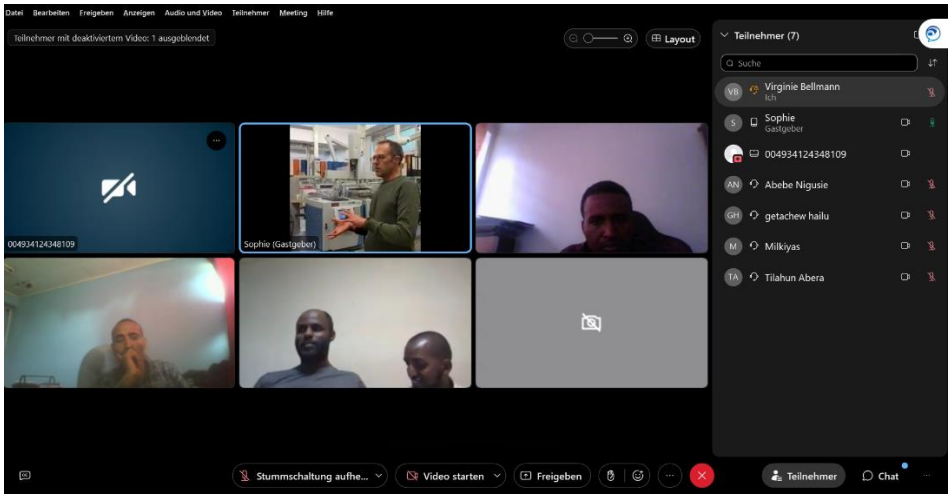
*Find video recordings / slides of the presentations and the tour at
https://edms.dbfz.de/seafile/d/ab87c5612e0a4ee6a6c6/

DBFZ (https://www.dbfz.de/)

Competence Profile

The DBFZ (Deutsches Biomasseforschungszentrum) was founded in 2008 as a limited liability company (GmbH) and develops practical solutions along the value chains and cycles of biomass that are based on the “Smart Bioenergy Approach”. Through applied R&D of technologies for the utilisation of biomass to produce energy and integrated materials, we are contributing to the achievement of a climate-neutral society, which, according to our vision, should become a reality by no later than 2050. The required transformation of the energy system can only succeed by massively reducing energy consumption, increasing energy efficiency, and steadily expanding renewable energies. A climate-neutral circular economy is based on optimised, closed “green” carbon cycles. By networking closely with numerous partners from science, industry and society, the DBFZ plays a key role in the development of rural areas - which are the points of departure for transition towards a bioeconomy. DBFZ’s cooperation with international partners fosters the global transfer of knowledge and technologies.

Tour of the DBFZ biogas facilities



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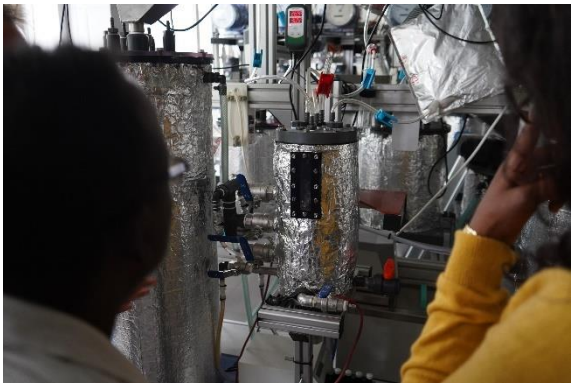
Biogas lab

The biogas lab is designed and equipped to simulate large-scale technical processes on a laboratory and semi-technical scale - complete with the relevant analytical processes. The aim is to optimise processes and to improve our basic understanding of the individual sub-processes involved in methane formation. Extensive (continuous and discontinuous) pilot plants with reaction volumes between 0.25 and 500 litres, as well as a research biogas plant are available.



Research biogas plant

The research biogas plant extends the range of application-oriented research at the DBFZ and allows to improve our understanding of processes and the efficiency of biogas production. The large-scale fermenters enable experiments to be conducted on a practical scale, thus ensuring that the results can be easily transferred to implementation.

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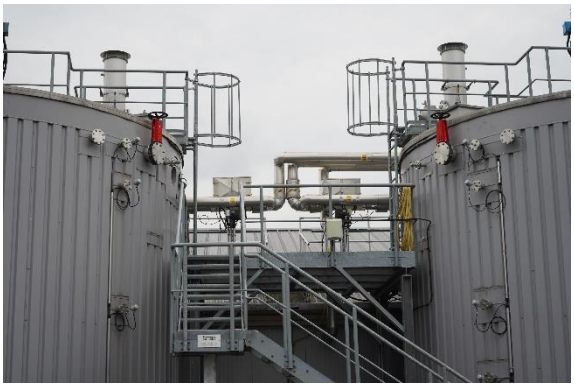

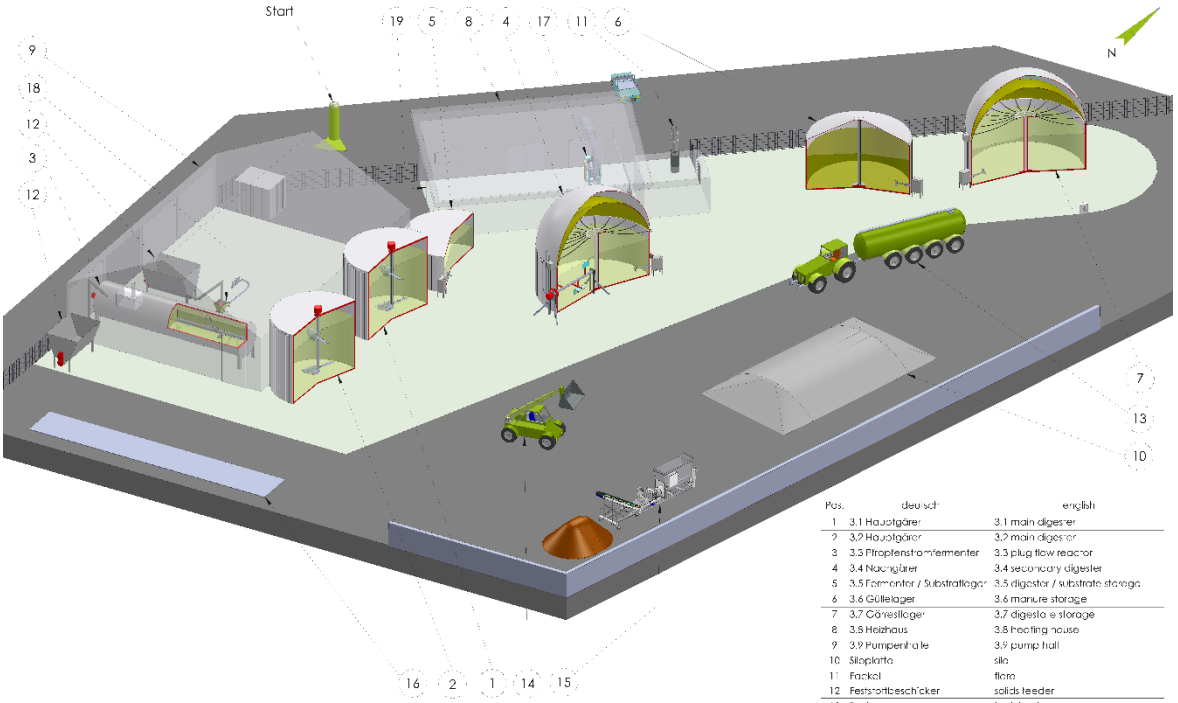

Pos.	deutsch	english
1	3.1 Hauptgärer	3.1 main digester
2	3.2 Hauptgärer	3.2 main digester
3	3.3 Pfropfenstromfermenter	3.3 plug flow reactor
4	3.4 Nachgärer	3.4 secondary digester
5	3.5 Fermentor / Substratlager	3.5 digestor / substrate storage
6	3.6 Güllelager	3.6 manure storage
7	3.7 Gärrestlager	3.7 digestate storage
8	3.8 Heizhaus	3.8 heating house
9	3.9 Pumpenhalle	3.9 pump hall
10	Siloplatte	silo
11	Fackel	flare
12	Feststoffbeschicker	solids feeder
13	Tankwagen	tank truck
14	Teleskoplader	telescopic loader
15	Zerkleinerungsaggregat	disintegration machine
16	Unterflurwaage	floor scale
17	Blockheizkraftwerk - BHKW	combined heat & power unit - CHP
18	Anmischpumpe	mixing pump
19	Schaltwarte	control center

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Forschungsbiogasanlage
research biogas plant

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Combustion lab

In the combustion lab, the DBFZ conducts experimental research on the thermo-chemical conversion of raw or pre-conditioned biomass. Exhaust gas emissions and particulate formation processes are also analysed. Pilot plants of our own design, as well as operational plants are used to conduct research on combustion processes and combustion plants. In the DBFZ's fuel-conditioning lab and analytical lab, various tests and experiments are carried out using extensive and proven know-how. The combustion lab also has equipment and facilities to investigate emission reduction processes for the development of solid catalysts and dust separators.

Biochar production is performed using lab and bench scale equipment like muffle furnaces and autoclaves that can be inertized with nitrogen, a fixed bed biomass gasifier or pyrolysis cook stoves. Test at the latter devices can be accompanied by efficiency and emission measurements. To investigate utilization options for biochar from pyrolysis and gasification, the materials can be characterized in a well-equipped analytical laboratory at DBFZ. In addition, agglomeration tests (e.g. comminution, pelleting, briquetting) can be performed. DBFZ scientists are involved in biofuel and biochar standardization on national and international level.

Biorefineries technical centre

The biorefineries technical centre at the DBFZ investigates and develops basic chemicals as well as the essential process steps for the conversion of biomass resources into solid, liquid and gaseous bioenergy sources. Hydrothermal processes (HTP), biomass gasification, gas purification/conditioning and catalytic syntheses as well as various treatment technologies can be studied using a wide range of testing facilities and measurement technology. Measurements can also be conducted at external plants.

Data lab

All DBFZ employees have access to a modern IT infrastructure that includes service support, a computer centre and assistance in matters pertaining to research data management. A high-performance environment is in place to efficiently process our research data, including the use of various programming languages and models, a relational database management system, geographic information systems and the ability to create web applications. A research data structure is currently being developed for the systematic storage of essential data on bioeconomy research.

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Science in society

The DBFZ transfers its knowledge primarily through research reports, journal articles and other scientific publications. Due to its prominent position within the scientific community, the DBFZ often takes on a leading role in national and international research associations in order to strengthen and disseminate the consensus on various research topics. Research results are also transferred to industry in the form of products and services. Projects facilitate knowledge co-creation with society while policy papers serve to inform public policy. This not only provides decision-makers with a basis for making scientifically sound decisions, but also raises awareness of socially relevant issues through multipliers. When drawing up policy recommendations, due consideration is given to the internal and interdepartmental priorities of the ministries. DBFZ staff members also lend their scientific support to the development of various research and policy strategy papers issued by the German government, e. g. the development of the German government's strategy on the bioeconomy.

ETH-Soil – Introduction

Ethiopia strives for an agricultural transformation to achieve food security, more rewarding jobs in rural communities and climate change adjustment.

The German Federal Ministry for Economic Cooperation and Development (BMZ) is committed to support the transformation of agricultural and food systems (social, economic and environmental). With ETH Soil, the DBFZ, is entrusted to contribute its expertise. For optimised biofertiliser production, suitable organic residues will be employed in fermentation, pyrolysis and different composting processes. Formulation and application tests will result in evidence-based receipts for different crops and soils. Ultimately, smallholder farms will benefit through increased food security and climate resilience of their operations.

The project partners aim at soil activation and productivity increases with carbon sequestration.

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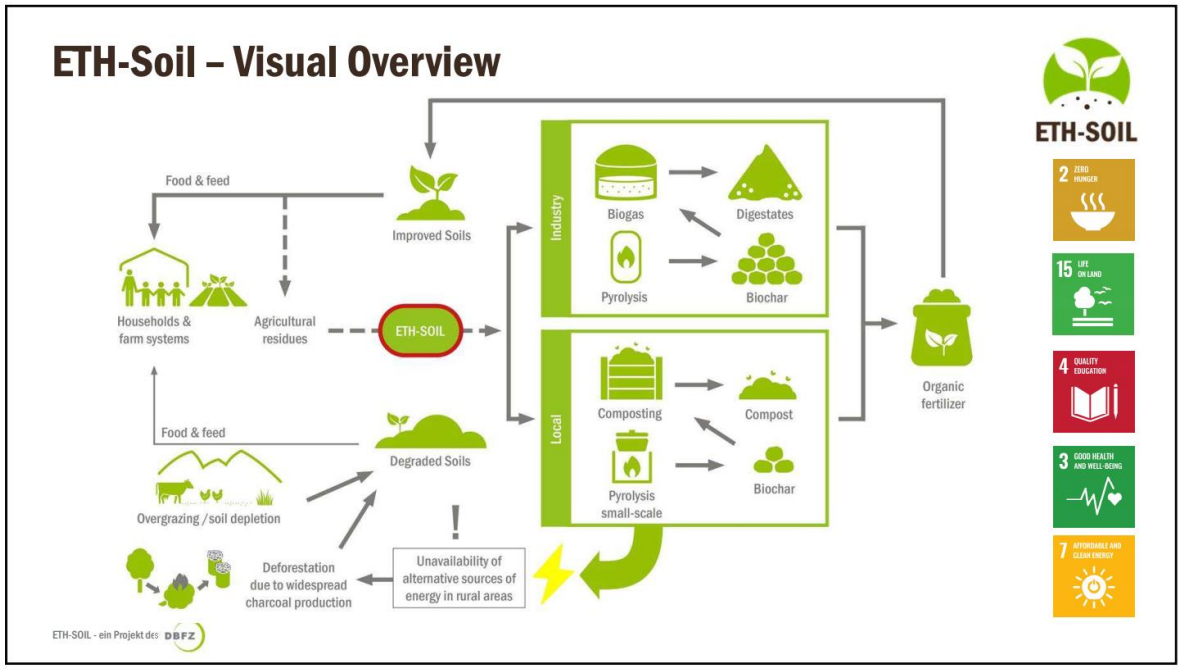

The study tour on composting (technologies) and biochar-based biofertilizer production serves the following aims:

1. Participants of the Jimma University should get to know commercially active bio-fertilizer manufacturers who work on different levels of technology during the course of the study trip. They shall become able to develop an idea of how an economically viable continuous operation of biochar-based biofertilizer production could be designed with different composting processes. The digestates of the Jimma biogas plant shall be used in the process. In the course of the trip, the economic dimension (investment and running costs versus potential income with different fertilizer qualities) should also be recorded and processed for decision-making.
2. The participants of the Oromia Agricultural Research Institute (IQQO, employees from the research centers at Zeway and Assela) should use the trip differently: Assela participants shall be examining the possibilities of own development or adjustment of tools / mechanical aids for biomass preparation for pyrolysis as well as fertilizer mixing and pelleting. Meanwhile participants from Zeway shall gain orientation and strengthen own (consulting) competence on composting / biomass preparation / fertilizer production.

https://www.dbfz.de/en/eth-soil/start

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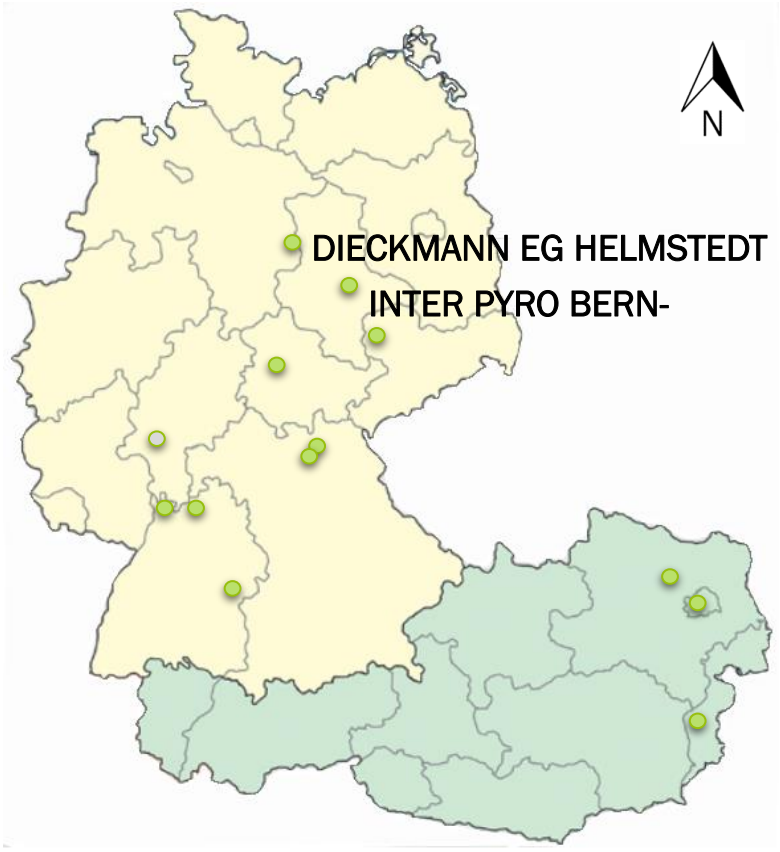
DAY 2 (29TH AUGUST 2023)



Project „InterPyro“ - Municipal potential uses of Biochar

Inter-municipal application of pyrolysis technology with biomass waste as feedstock for CO_2-negative energy production and soil improvement

©Fraunhofer UMSICHT

In the „InterPyro“ project, we looked at the use of biomass for CO_2-negative energy production and investigated the municipal potential for strengthening regional value creation.

In order to investigate the usability of biochar, the project partner Anhalt University of Applied Sciences is conducting a field trial in Bernburg-Strenzfeld. Two test plots and one control plot are being compared. A humus-consuming crop rotation with silage maize as the main crop in the harvest year 2022 and winter wheat as the preceding crop is being investigated. In the control variant, the plot lies fallow over winter and remains uncovered. In two other variants, yellow mustard was drilled out as an intercrop in September 2022 and the soil was treated. This pre-treatment was carried out in one of the two test plots with conventional digestate and in the second test plot with a TCR® biochar-digestate mixture, which was incorporated into the soil. The mixture was prepared 8 days before application in a 50/50 mass ratio, so that a "loading" of the biochar could take place. This "loading" was based on the assumption that nutrients and water from the digestate could be absorbed by the biochar. The absorption of nitrogen compounds has been proven in laboratory tests.

Background to the „InterPyro“ project:

The „InterPyro“ project aims to contribute to a climate-neutral future by improving the soil with so-called TCR biochar. The basis for this is thermo-chemical reforming (TCR®), a thermo-chemical conversion process in which organic compounds are split at high temperatures under absence of oxygen. The end product of this process is TCR biochar.

Contact person: Jeannine Dallmann, jeannine.dallmann@hs-anhalt.de, +49 (0) 5351 537502
Contact for biochar: Dr. Andreas Apfelbacher, andreas.apfelbacher@umsicht.fraunhofer.de

Links:

https://www.rkw-sachsenanhalt.de/innovation/interpyro/

https://www.barleben.de/Startseite/NL-012-Projekt-InterPyro-Feldversuch-zur-Nutzbarkeit-von-Pflanzenkohle.php?object=tx,936.724.1.&ModID=7&FID=2276.20845.1&NavID=2276.48

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Biochar and digestate are mixed with a machine and is afterwards stored in containers where it rests for 4 - 6 weeks.

Biochar before loading with digestate.

Biochar loaded with digestate.

The biochar is worked into to soil either by ploughing or by using a mounted cultivator. Application depth is 15-20cm.

Test field with maize: 1) Digestate, 2) Biochar+digestate, 3) Control

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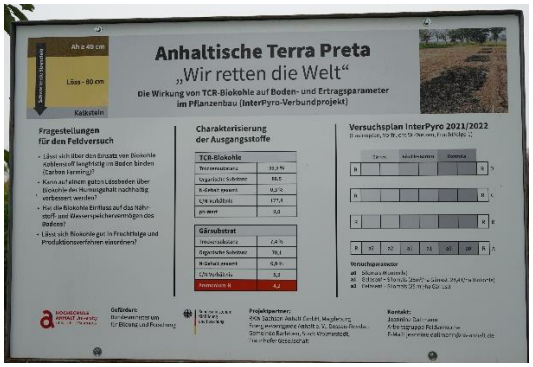
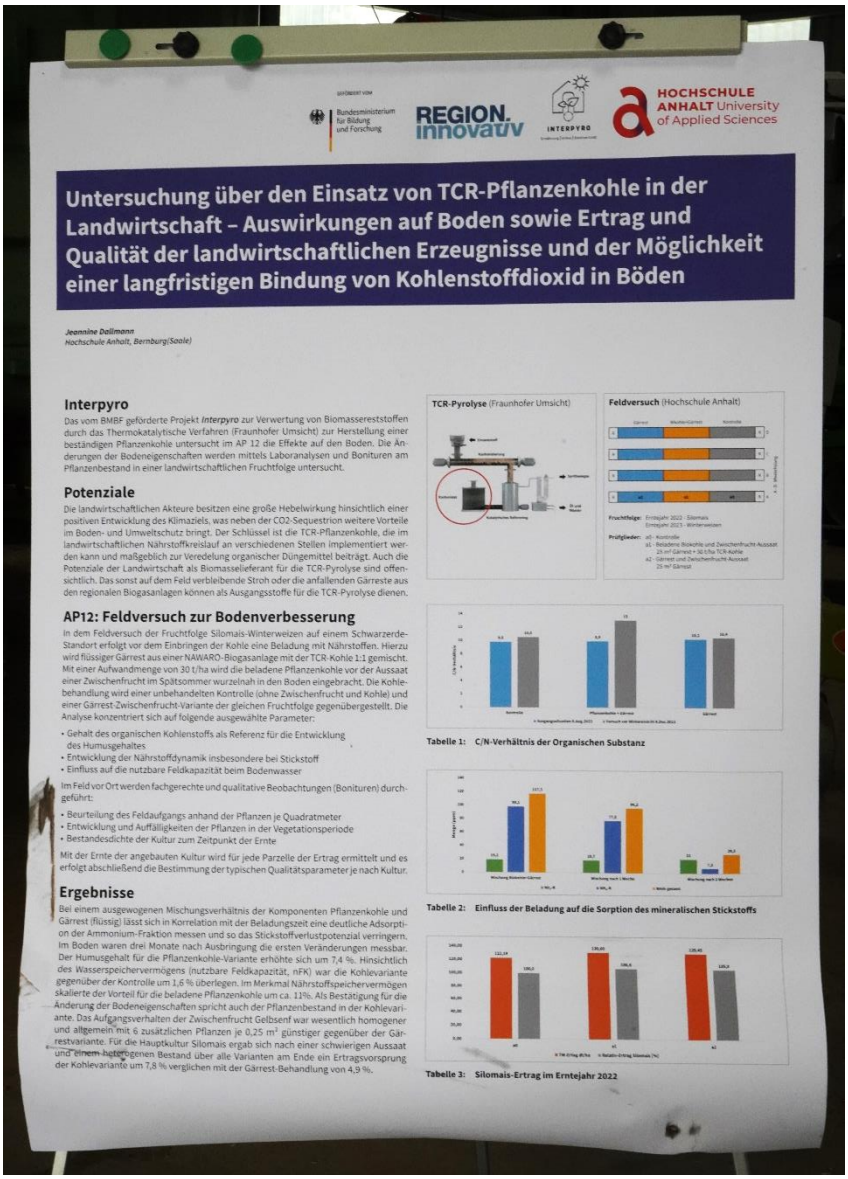


Test field for wheat.



Biogas Plant with Biochar Application Bioenergy Dieckmann e.K.

Dieckmann e.K. are operating a Biogas plant with biochar application in a stirred tank fermenter. The biochar used in the biogas process is produced by company LUCRAT GmbH (more information refers to: https://lucrat.de/#BioChar). The biochar is taken to the feeder together with the maize and the other input materials (cow, chicken and turkey manure) and from there it is fed into the fermenter. The biochar used in the biogas plant is made from hardwoodchips, produced in Poland. Per 1 tonne of substrate 35 kg biochar is applied. Different sizes of biochar were tested. 5-10 mm yielded the best results. The quality and quantity of biogas increased. Methane yield increased by approx. 5 %.

The coal is discharged from the fermenter via the separator. Afterwards, all the fermentation residues (solid and liquid phases) are provided free of charge to farmers as fertilizers.

Technical Information of the biogas plant: 2 high fermenters, centrally stirred - each with 3750 cbm fermentation volume, 1 biological desulphurisation, 1 gas storage with 2500 cbm volume, 4 BHKWs (combined heat and power plant) with a total of 1690 kW installed capacity - operated at 1200 - 1250 kW, 1 solid input with a volume of 120 cbm (liquid feeding), 1 separator (everything that comes out of the digesters is separated), 3 gas-tight fermentation residue stores with a capacity of 16000 cbm

The biogas plant is located on the B244, exit Helmstedt towards Schöningen, in 38350 Helmstedt.

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Plant within farmland in Helmstedt.


Digesters.


The plant is being expanded in order to produce biogas for the transportation secor.


Maize silage.


Biochar from hardwood chips.


Feedstock is supplied by a screw pump.

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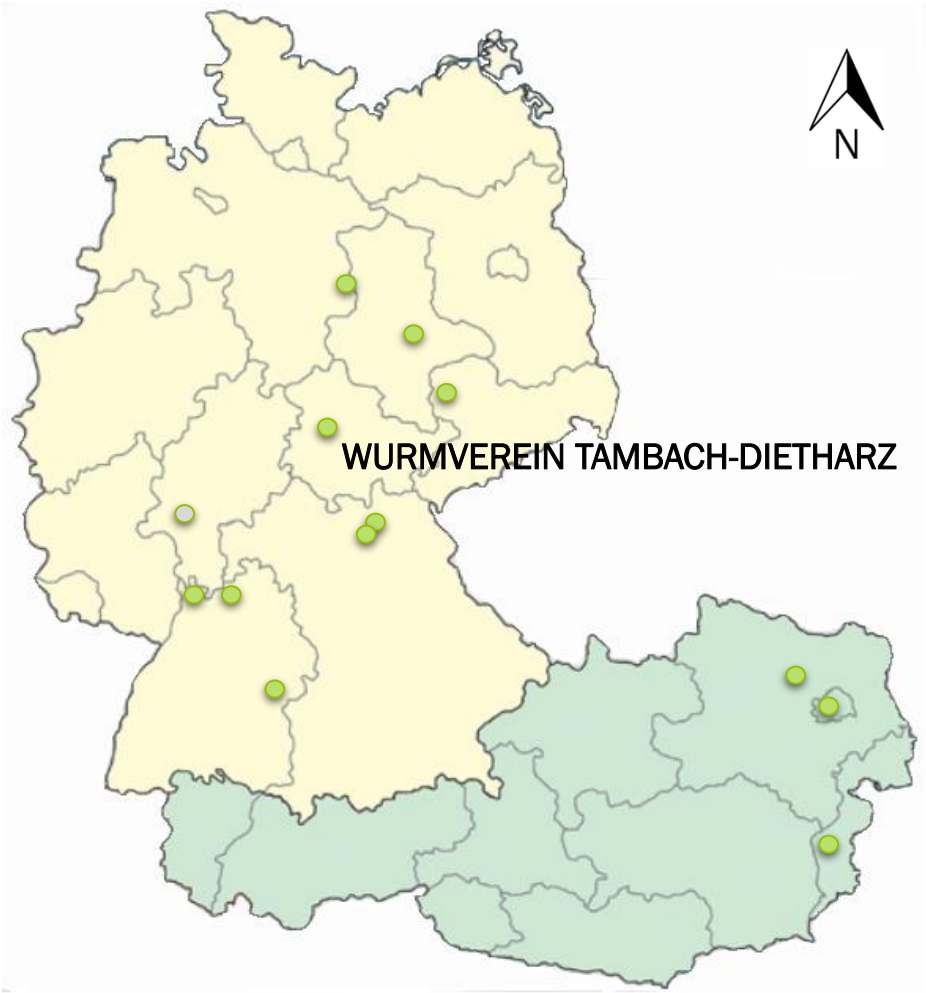
Solid phase of the digestate – it turned darker due to the biochar.

Biogas storage 2500m3. The CHP produces 1600 kWh. All of the process heat is used in the plant itself.

DAY 3 (30TH AUGUST 2023)



Contact:

Verein zur Förderung vermitativer Abfallverwertung & Humusproduktion e.V. (Wurmverein)
Günter Hebestreit
Nordstraße 12
99897 Tamach-Dietharz

Mobile: +49174-6472694

Email: vermis@t-online.de

Links:
https://wurmverein.de/
https://www.vermisshop.de/

Vermicompost production “Wurmverein” – Tambach-Dietharz

In Thuringia, in the small town of Tambach-Dietharz, you'll find the mediated biowaste facility. This small-scale vermi-composting facility is handling the municipal organic waste, that is collected in Tambach-Dietharz, since 1992. In this small town live about 4300 inhabitants. The organic waste is collected by the municipality and transported to the “Wurmverein”.

There the waste is preselected, non-organic matter is sorted out and shredded. After this, it is placed in beds and composting worms, mainly *Eisenia hortensis* and *Eisenia foetida*, are transferred to the beds. The worms break down the organic matter under aerobic conditions. Mechanical mixing of the waste with the soil is not needed, the worms do it themselves due to their natural movement. They feed their way up to the surface until everything is humified. When the worms are visible at the surface, it is sign of a finished, completely humified windrow. The finished humus is covered with a plastic foil to dry the material. The worms move on to find food in another windrow. The production of the worm-humus takes three months from start to finish. The worm windrows are 40 m long and 3 m wide. 3100 liters of waste are refined into humus in a week.

“Wurmverein” is a private association, which was founded by a group of inhabitants from Tambach-Dietharz, eager to contribute to sustainable organic waste treatment and processing. The processes work with a low level of mechanisation and are monitored by the experts with long years of experience in vermi-composting.

The association’s brochure in English language can be found here:

https://edms.dbfz.de/seafile/f/97e4e0b207ca41dbbe80/

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Three windrows at the Wurmverein site. Active windrows are not covered, rain is drained by the worm holes. In hot and dry weather, irrigation is needed.

In summer season the Worm association receives 1500 kg of organic waste. 1 kg waste needs about 25 worms.

The finished humus is covered until it is stored in a dry space.

Finished worm humus.

Mechanic screener for three grades of coarseness.

Final packaged product.

Goods declaration for BIOVERM worm castings (also printed on the back of the bag)

It is an organic NKP fertilizer 1.6% N total nitrogen // 0.6% P205 total phosphate // 0.5% K2 total potassium 0.7% MgO magnesium oxide // 3.3% CaO calcium oxide // 52.4 % organic matter

Composition: 85% organic waste from separate collection from private households, 15% vegetable waste from gardening and landscaping.

Production: Aerobic (with the supply of oxygen) utilization of the above-mentioned biowaste by means of small animals (worms) through digestion.

Instructions for use: More than 90% of the total nitrogen is in organic form and is not immediately available to plants. Up to 1.5 liters of worm castings are recommended per m^2, which corresponds to a maximum of 14.4 g nitrogen/m^2, 0.5 g phosphate/m^2 and 4.5 g potassium oxide/m^2.

Notes on storage: Store dry and below 40°C

Net weight: 1.0 ; 1.5 ; 2.0 or 5.0 liters

Placer on the market: Association for the Promotion of Vermitative Waste Utilization and Humus Production e.V.

Other information (average): volumetric weight: 600 g/l grain size: 0.2 - 3 mm soluble salt content: 2.6 g/l pH value: approx. 7.2

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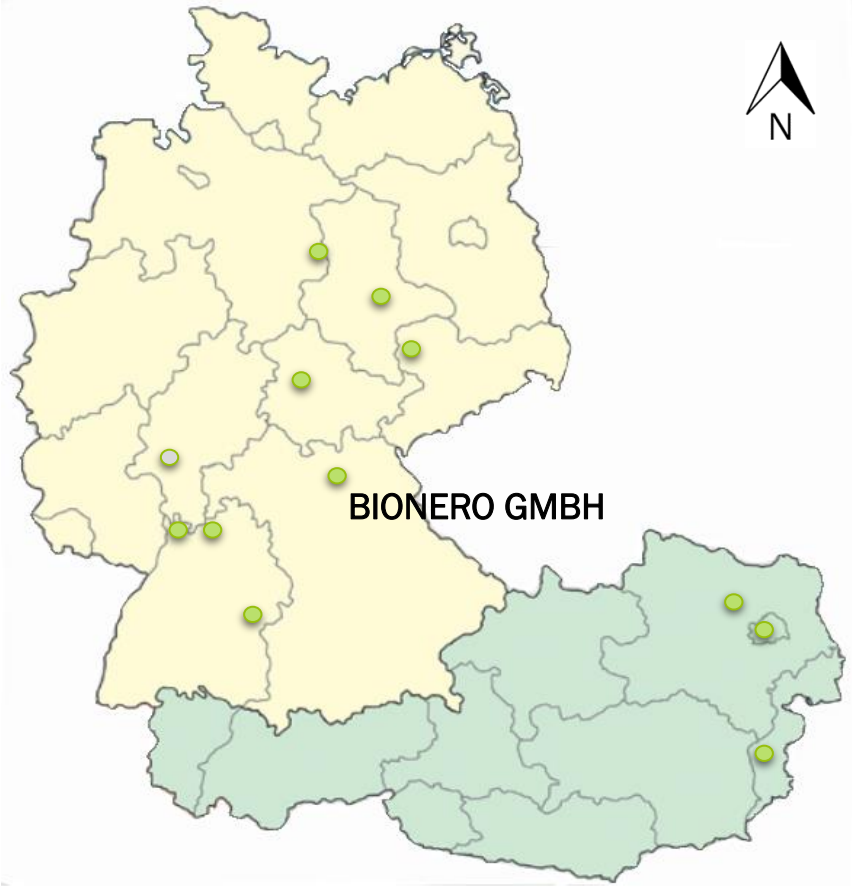
DAY 4 (31ST AUGUST 2023)



Contact:
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95349 Thurnau

Tel: +49 9228 997892-0

Email: info@bionero.de

Link:
https://www.bionero.de/ueber-uns-neu

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Biofertilzer production Bionero GmbH – Thurnau




Bionero is a highly efficient young family business based near Bayreuth. They developed a state-of-the-art, industrialized process that produces a highest-quality plant charcoal from biogenic residues and transforms it into fertile black earth.

With the help of Professor Bruno Glaser, who teaches at the University of Halle-Wittenberg and is considered a pioneer of Amazon Earth, an industrialized manufacturing process was developed that produces charcoal from biogenic residues and wood chips. The plant charcoal is refined in further processing steps and matures into a highly effective and ready-to-use growing medium that even surpasses the quality of the original Terra Preta. bionero's organic soils are thus the first and only industrially produced ready-to-use Terra Preta concepts in Germany.
Thanks to the latest mixing technology, it is possible to mix formulations with percentage accuracy. bionero is playing a pioneering role and is the first company in the world to combine all the necessary process steps on the way to certifiable carbon sinks.

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The product

- Bionero produces 1t of biochar from 4t wood chips (birch and spruce), which are provided by surrounding timber industry.
- Horse manure from the family‘s farm is composted together with green bio waste and their biochar at a cooperating composting site.
- On average, biochar takes up to 15% of the compost but can take up to 70% depending on the specific use case for the resulting compost.
- The compost is then mixed with other ingredients such as wood fiber, sand or clay granulate depending on the use.
- The finished soil is weighed, packed and shipped to retailers or directly to their customers.
- Customers include retailers, farmers, horticultural businesses etc.
- The soil/fertilizer is applied once a year according to the existing soil.

The process

- Bionero use a Pyreg P500 pyrolysis reactor.
- Their pyrolysis plant is running continuously, it takes 45 minutes to complete the charring.
- They only need electricity to start the pyrolysis until the point when there is enough gas for a self-sustaining process. Learn more on the manufacturer‘s site.
- The charring is happening at 750 °C, the resulting biochar has a carbon content of 93%.
- Additionally, they experiment with smaller, low-tech reactors pictured below:

The vision

- Their vision is a global, decentralised infrastructure, that uses residues provided by the customers who in return receive an equivalent amount of biochar.
- They are registered as carbon sink via the European Biochar Certificate and hope to expand its effect.

Business presentation

German language documentary about Terra Preta (English subtitles available)

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DAY 5 (1ST SEPTEMBER 2023)

Contact:
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Circular economy Neckar-Odenwald, AöR (KWiN)
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74722 Buchen

Email: m.hahn@awn-online.de

Link:
www.kwin-online.de

AWN Neckar Odenwald mbH – Buchen

The waste management company of Neckar-Odenwald mbH (AWN) has been responsible for municipal waste management issues throughout the district since it was founded in 1992.

More than 20,000 t of green waste from gardens and landscape maintenance measures accrue in the Neckar-Odenwald district every year. It is collected and recycled via numerous green waste sites and collections.
The herbaceous part (leaves, grass) is composted, the woody part of the green waste, which is still full of energy, is put to good use in the decentralized biomass heating plant. In the new biomass center on the grounds of the Sansenhecken landfill in Buchen, a plant for the production of plant charcoal has recently been installed in order to open up further ways of refining green waste.
With this plant from the German manufacturer Pyreg GmbH, it will now be possible to refine regional biomasses such as green cuttings from green waste sites, grain husks from agriculture or wood chips into plant charcoal. This plant operates on the principle of dry carbonization. Around 800 metric tons of regional biomass are used to produce around 200 metric tons of plant carbon.
Biomass used is carbonized at approx. 800 °C. Synthesis gas is completely combusted at 1200 °C, so that only very low emissions are produced.
The permanently generated waste heat of approx. 150 kW is used for the drying processes.

The products and activities of waste management company AWN are certified according to European Biochar Certificate.

Find the presentation about AWN in German and English here.

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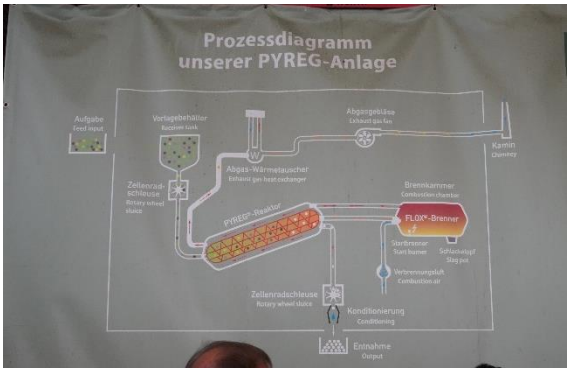

AWN use a Pyreg plant for pyrolising woody biomass. 600 t wood chips are processed into 200 t biochar every year.

For drying the used wood, exhaust heat (130kw) from the plant is led into the wood containers.

The wood chips - mostly from birch, pine, spruce and oak - have a max. size of 25mm and have a humidity content of 30%.

The biochar is used in composting, as feed supplement and bedding for cattle as well as in construction.

AWN‘s biochar is certified by the European Biochar Initiative in their highest grade.

They produce four different types of compost: Basic compost fresh and finished (5.500 tons p.a.), Nutrient compost and Terra Preta (together 2000 tons p.a.).

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Biomasses for composting include green waste, manure and wood from municipial forests.

Green waste and woody materials are shredded and sorted for composting.

Ventilation for basic compost heaps.

Basic and fresh compost consist of fine grain green waist that are being composted for 6 or 3 weeks respectively.

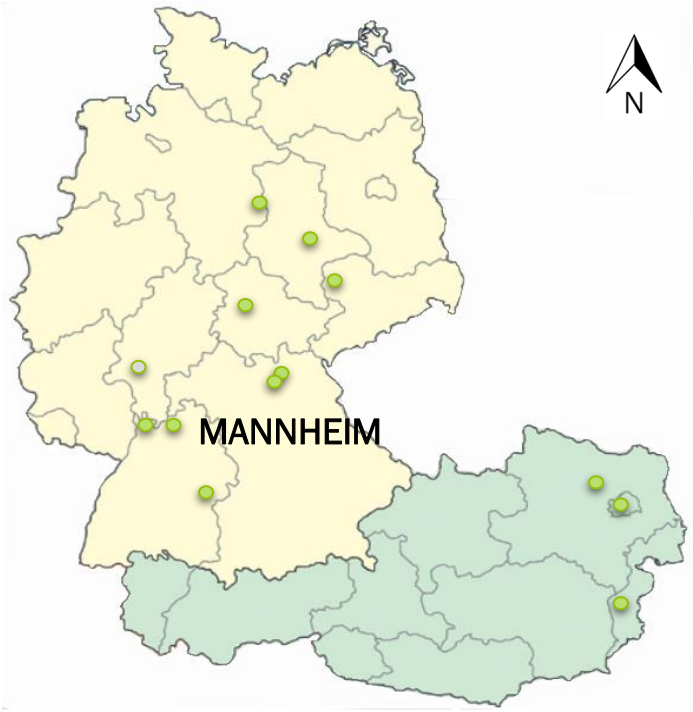
The nutrient compost and Terra Preta are composted for 12 weeks. The windrows are regularly turned and irrigated by a machine.

The nutrient compost is produced by employing the controlled aerobic composting method according to Hildebrandt-Lübke.
For Terra Preta, 10 % biochar is added and co-composted. Find more details on the nutrient contents here.

DAY 6 (2ND SEPTEMBER 2023)

Resting day, time for shopping and cultural programme in Frankfurt including a visit to Paulskirche, site of the first German parliament in 1848.

DAY 7 (3RD SEPTEMBER 2023)



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Visit to BUGA in Mannheim (Federal gardening exhibition)

BUGA takes place every year in a different German city. This year‘s BUGA is in Mannheim. Next to flower beds and special plants there are informational parts e.g. about sustainable development goals.

SDG 5 – Gender Equality

SDG - 10 Reduce Inequality

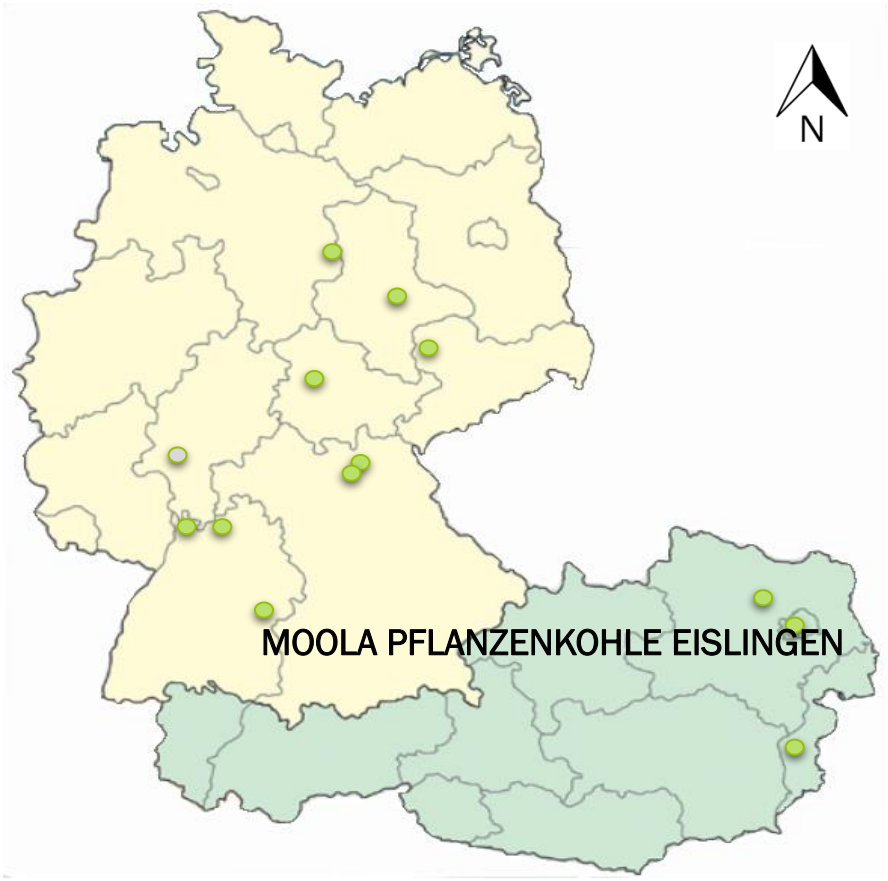
SDG 14 - Life below Water

Global field: Equally devided, every human on earth has 2000 m² of agricultural land. More info here.

Intelligent tractor with advanced GPS and multi fuel concept.

Fertilizing drone.

DAY 8 (4TH SEPTEMBER)



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Moola Biochar – Eislingen

“Moola biochar” is an affiliated company of “Fetzer Rohstoffe + Recycling GmbH” and is located in southwest Germany.

The first pyrolysis went into operation in 2012. In the first year, it was mainly used to generate energy for sustainable heating. In the beginning, only regional waste from mills and pulp from label production were used to generate energy through the pyrolysis process. Soon, the quality of the resulting coal was recognized and certified with the EBC (European Biochar Certificate) in 2013. From then on, only pure biomass was used as feedstock and more attention was devoted to the refinement and various applications of plant carbon.

The cultivation of the own test fields, the cooperation with other companies and the participation in various research projects at home and abroad enable a lively, diverse further development of the technology. Since 2018, a total of two pyrolysis plants are now in operation, producing about 1 million kWh equivalent of heat and about 1,500 cbm of high-quality biochar per year.

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Moola use Pyreg pyrolsis plants to produce biochar from wood chips (max. size 3cm) which are dried on site. The process takes place at around 500-700 °C. The biochar is cooled by water after the pyrolysis. From 3 t of wood 1 t of biochar is produced.

Coarse biochar is used for composting and as the base for a fertilizer.

They use the liquid phase of digestate from biogas plants as fertilizer to load the biochar.

The digestate is manually sprayed on the biochar with a watering can. 120l digestate is used for 2 qbm biochar.

Fine grain biochar is used for animal feed, suitable for all animals.

Special mix for animal bedding.

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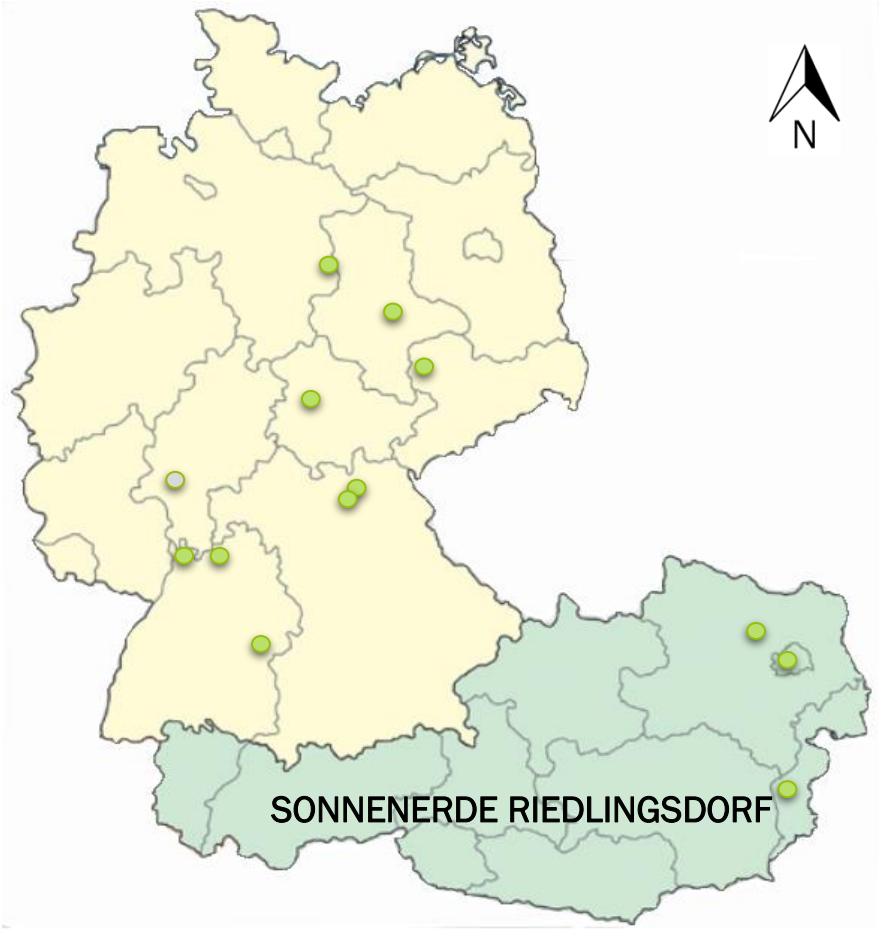
DAY 9 (5TH SEPTEMBER 2023)



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Sonnenerde GmbH – Riedlingsdorf, Austria

Sonnenerde is Austria's leading company in the field of plant charcoal production and product development from plant charcoal. In addition to various highly fertile black earths, the company has also developed the “urban tree” fine substrate (for the Stockholm tree planting system), the slurry charcoal and various fodder charcoals.

Four different types of compost are produced in a multistage process, one of which is the biochar-based compost. This consists of chopped green and shrub cuttings, fruit waste, rock flour and 25% plant charcoal. The compost raw materials are placed together with soil in small triangular windrows and thoroughly mixed. Due to the small cross-section of the heaps and regular repositioning (daily in the first week, then 3 times a week), a 100% oxygen supply is guaranteed. If there is a risk of overflowing (e.g. prolonged rainy periods), all heaps are covered with fleece. In this way, the temperature in the windrows rises rapidly and subsides after 4-6 weeks. The cooled down windrows are then sent for humification. Afterwards, the now well-matured compost is mixed with the individual aggregates (e.g. sand or clay) and the finished soil mixture is sieved.

Continuous control consists of incoming inspection, continuous checking of the mixture and moisture, temperature monitoring and pH measurement if required. Furthermore, the compost heaps are regularly checked for their gas composition and the data of CO_2, O_2 and CH_4 in the heap body are collected. Thus, the correct rotting biology can be controlled and immediate reactions to any undesirable developments are possible. Independent institutes monitor the plant and carry out regular sampling so that compliance with the Federal Compost Ordinance is guaranteed.

Gerald Dunst stressed important aspects of the application of biochar as a soil amendment:

- Always loading biochar before soil application.
- Covering soil to protect nutrients and microbes (with mulch, residues etc.).
- Focussing on the microbiome and fungi in the soil.
- C-N-ratio of 10:1 in Terra Preta.

Scientific papers on which Sonnerde’s work is based can be found here.

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Composting

Four types: Green compost, Organic compost, Biochar compost (base for Terra Preta), Acidic compost

Green compost: First thermophilic fermentation of green waste for 4 weeks (up to 100 °C). Afterwards, it's mixed with sewage/bio sludges in a 1:1 ratio, together with 5-10 % rock powder.
Video explanation (in German):
https://youtu.be/ponsfHe3UQk?

Organic Compost: Green waste, industrial food waste and rock powder. **Biochar compost**: Organic compost with 25% biochar and 10% rock powder. **Acidic compost**: Green waste, milk sludges, rock powder and sulfur to achieve a pH-value of 3,0.
In general, same method as green compost

The compost feedstock is quite coarse, including stones and bigger sticks. Those are sieved after the fermentation. Stones serve as mineral source for biochar production while the coarse woody material ensures good aeration.
Woody material covered in mineral dust is the feedstock for the biochar. The minerals improve the qualities of the biochar.

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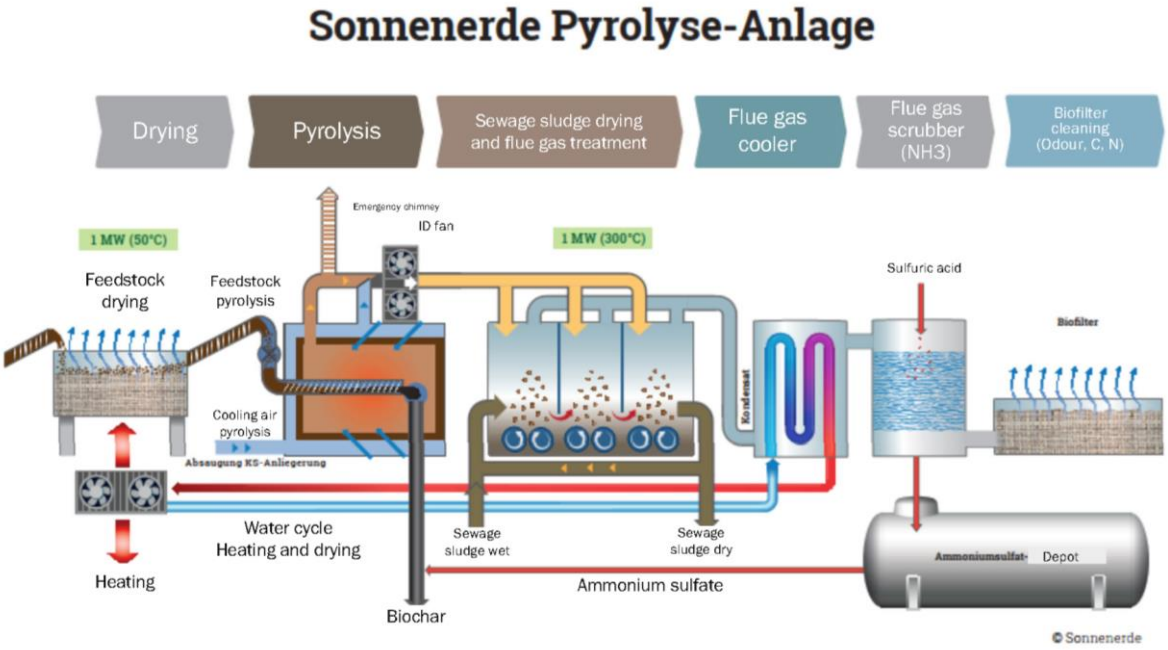
Biochar production

Sonnenerde just recently started operating their new combined pyrolysis-drying-plant that they developed jointly with engineers and machine manufacturers (e.g. PyroDry).

Before and still for specific biochars, they use a Pyreg plant.



The feedstock for biochar includes small plastic pieces that will be completly combusted during pyrolysis.

Pyrolysis plant. The heat from the process is cooled down to 300°C and used for drying sewage sludge.

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The dried sewage sludge is pelletized without any binding material and taken to incineration. The treatment of sewage sludge provides an additional source of income to Sonnenerde.

All exhaust gases and odours are filtered by miocrobial enriched woody material (biofilter).

After pyrolysis, the biochar for Terra Preta is sprayed with ammonium sulfate to load it to a content of 10:1 C-N-ratio.

For the different soil products, additional material is added to the compost, e.g. clay substrate, washed sand, horn shavings etc.
The clay substrate is produced from old roof tiles.

For Terra Preta, organic compost is mixed with 25% biochar, 10% rock powder, 5% clay substrate, sand and horn shavings. Microbially, their product is over 90% identical to the original Terra Preta.

Wheat husks and sunflower seed hulls are the source for a biochar used in feed char mixes. For the production, a Pyreg plant is used.

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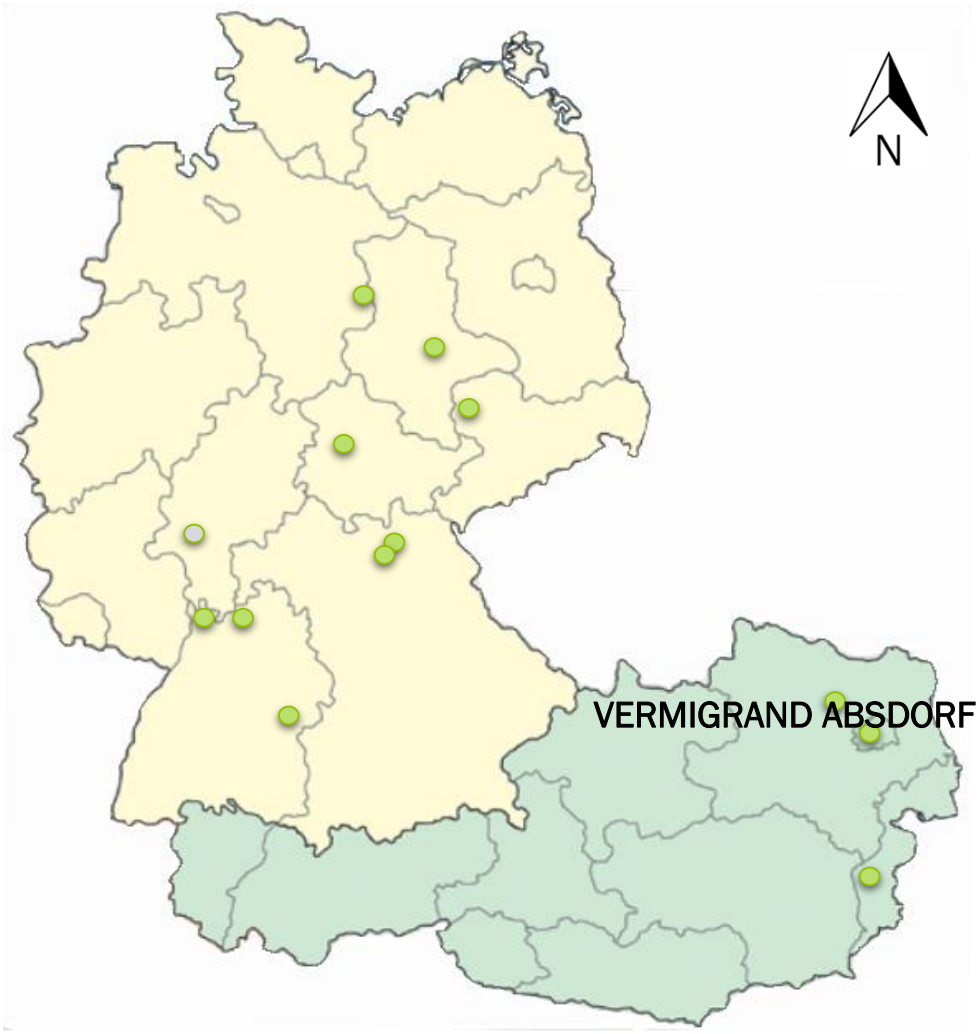
DAY 10 (6TH SEPTEMBER 2023)



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Vermigrand– Absdorf, Austria

Alfred Grand and Leopold Fischer founded Vermigrand Naturprodukte GmbH in 2010. Already since the late 1990s, they have been working on the best method to produce vermicompost as a biofertilizer. Next to the vermicomposting company Vermigrand they also have an organic research farm, operating under the name Grand Farm - farm for research and demonstration since 2018. They are part of the EU Horizon and Erasmus+ programmes. More info: www.grandfarm.at

Additionally, they produce organic vegetables at their market farm which serves local subsciption boxes. More info: www.grandgarten.at

The VERMIGRAND method consists of a multi-step process. Only feedstocks from sustainable renewable resources such as organic lucerne, cereal straw and hemp straw are used. Shrub cuttings and fermentation residues from a biogas plant are also used. All raw materials are subjected to a hot rotting process. During this process, temperatures of up to 65 °C are reached. Mixed and aerated several times, hygienization takes place. At the end of this process, the raw materials are friable, soft and homogenized. After this phase, the raw compost is sieved and then fed to the earthworms.

The VERMIGRAND worm composting system is developed-in-house that operates continuously. It contains compost worms, which also live in nature only in the uppermost layers of soil (epigean earthworms). This makes it possible to harvest the material introduced as feed after about ten weeks in the lower area of the plant as pure, high-quality earthworm humus (free of earthworms or other small animals), while in the upper area thin layers of raw compost are fed several times a week.

Additionally, they co-compost 10 % (mass) of wood-based biochar for their VermiTerra biofertilizer. With co-composting the volume of biomass decreases by 50 % but biochar volume remains the same (so that in finished product is 30 % of biochar). In trials they could show that biochar supports population growth of the earthworms and that 10-15% of mass yields better results than 5%.

The harvested earthworm humus is then sieved and packed. It can either be used immediately or stored for up to two years.

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At a 2000 sqm concrete site in their farmland, they produce compost as feedstock for the vermicompost. The windrows are 4m wide, 1,5 m high, 40 m long and are turned with a machine every week.

Feedstocks include manure, wood and lucerne hay (*Medicago sativa*) which is rich in nutrients. They don‘t use organic waste or kitchen waste, because it is contaminated with plastics etc.

After the thermophilic composting process (10 weeks), the material is screened.
It is then either used for other compost products or to feed the earthworms.

The fine compost is mixed with horse manure and some flour to be fed to the earthworms.

The windrows for vermicompost are situated in a tent and covered by a canvas. They produce vermicompost year-round. New feedstock is provided every week and applied with a front end loader. It is stacked 6-8cm high.

Above 35 °C the windrows need to be irrigated. During cold winters (-20 ° C) a wood chip heating system is used to provide warm water which is lead through the windrows.

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Eisenia fetida & E. andrei stay at the surface but below the organic matter to avoid the light. A stable population has around 15.000 – 20.000 worms per sqm, minimum density 1000 worms per sqm as a start.

At the bottom is a grate and a harvesting tool cuts the layer below. Therefore, the worms stay in the windrow which is continuously fed from above.

The finished biofertilizer can be directly applied to the soil, but most effectively applied into the seed rill.
The retail is focused on the consumer market because it is too expensive for farmers.

Barrel for worm tea production.

For worm tea production, the barrel is filled with 100 l of water, different composts are added. Air is blown in from the bottom which provides oxygen and mixes water and compost. The process takes 24h, then aeration is stopped and the solids settle at the bottom. The resulting liquid is loaded with microbes from the compost. Seeds are watered for 10 -20 min in the worm tea, they dry out completely afterwards and can be used as usual. Effect: Germination index increases (more seeds germinate and faster). Hypothesis: The microbes provide pseudo-hormones to facilitate germination. The faster and more consistent the germination is, the better for agriculture, less weeds, less diseases, better plant biomass. The most effective method is spreading the microbes where they can grow, seeds feed and aerate the microbes.

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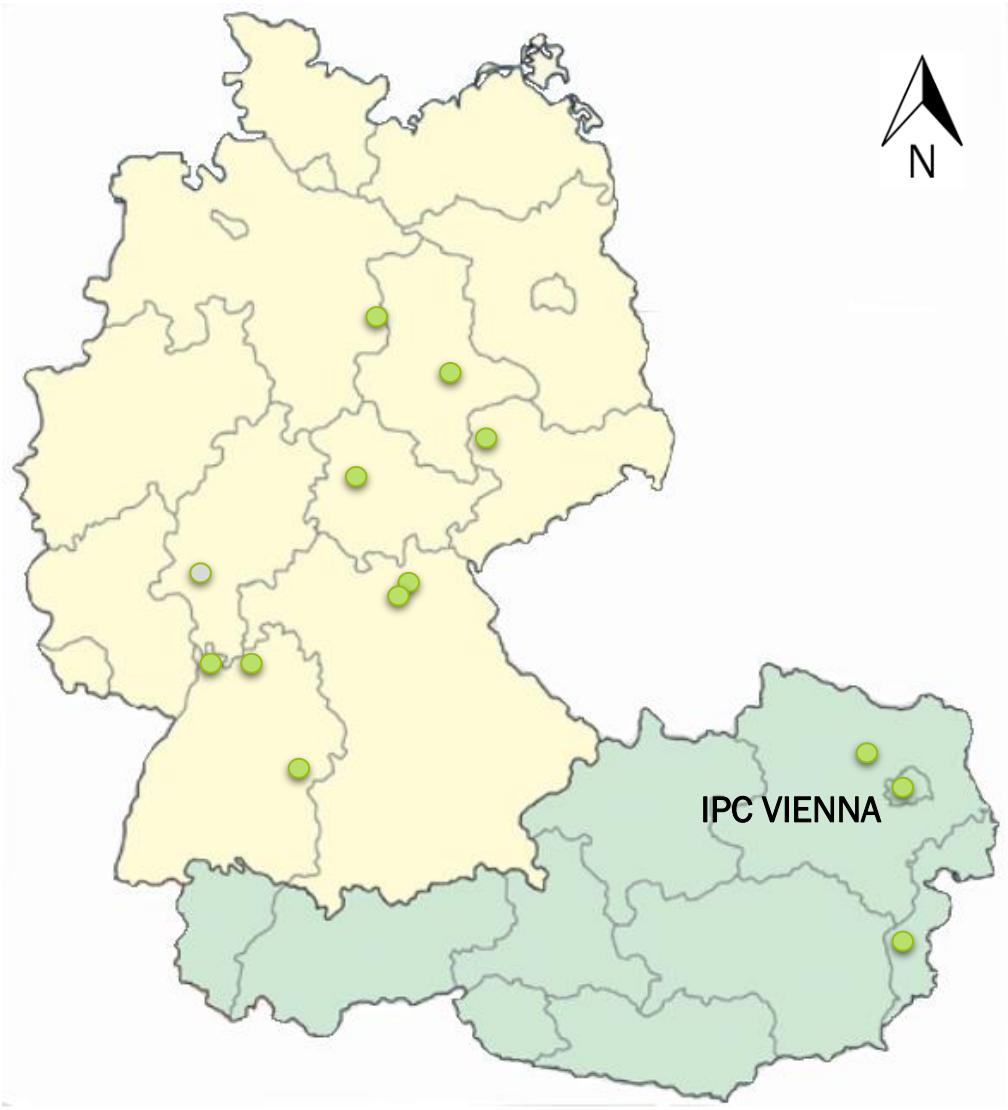
DAY 11 (7TH SEPTEMBER 2023)



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International Practitioner Day Composting– Vienna, Austria

The association of compost and biogas in Vienna invites to the “International Practitioners Day”. This event will take place at the site of the Lobau composting plant (MA48) in Vienna.

The development of new technologies through innovative partnerships between plant operation and plant engineering, promoted in particular in this country the successful development of environmental technology and the progress in the compost industry. There are challenges for practitioners, which can be countered with technical and innovative solutions.

For the 8th time, leading suppliers will present mobile machines for shredding biomass, latest technologies in the fields of turning, screening, measuring and controlling, manipulating as well as transporting to an international audience in Vienna. The KompOskar for the best compost in Austria will be awarded. The event is aimed at all practitioners, such as plant operators, waste handlers, waste management associations, farmers, contractors, planners, manufacturers, compost enthusiasts and commercial enterprises.

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Links:

https://www.kompost-biogas.info/ipt/

https://www.youtube.com/watch?v=FhIJhO86cpc

https://www.youtube.com/watch?v=wW8m7AI-V1o&list=PLxITTLNwK4uaGOFwlUdpbgeBvjOKecqCD

https://www.youtube.com/watch?v=rylEVKvmXu8

https://www.youtube.com/watch?v=kylwL_vJqrA

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Compost turner towed by a tractor. The compost is released to the side.

Rotor.

Tractor towed compost turner by Compost Systems. More info here.

This small and simple version was not part of the exhibition but seems interesting.
Video explanation: YouTube

High-tech compost turner Backhus by Eggersmann: It is partly automated (GPS), has a climatised operator's cabin including a fridge etc...
It can switch between side and back release of the compost. Windrow width 5 m

Partly automated compost turner by KompTech. It has similar features as the Backhus.

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There were several large Shredder/Screeners shown: Eggersmann, KompTech, Wima, Doppstadt

KompTech manufactures a variety of screeners, compost turners and shredders.
Find more info here.

This large screener by Eggersmann can be operated by Diesel or electric engine. They produce three sizes, this one is the biggest.
Find more info here.
Info on the purchase of used machines.

This shredder-screener combination is the smallest version Eggersmann offers. The shredder can process up to 15t per hour. We exchanged contacts with the manufacturer and will receive more information.

The last category was separators like this high-tech model.

This separator can be added to containers.

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DAY 12 (8TH SEPTEMBER)

Departure