

# GREEN CARBON FOR HEALTHY SOILS

## How REFERTIL technology converts agri-waste streams into organic fertilizers



### **The project: Knowledge-based development of bio-fertilizers for added-value crop production and soil improvement**

The REFERTIL project is introducing a new technology for the recycling of bio-based waste streams and their conversion into safe bio-fertilisers and bio-compost products. The waste streams, or organic by-products from food production and/or agriculture are processed in a new-generation carbonisation technology, known as '3R' Recycle-Reduce-Reuse technology. These 3R-conversion processes lead to a 'green' carbon end-product, the so called 'bio-char'. The new compost treatment system will improve conservation agriculture, low-input and organic farming, vegetable cultivation, plant breeding and crop production. As part of a circular economy, it will recover components and make the best reuse of waste streams.

### **Reducing chemosynthetic fertilizers, contributing to food safety and security**

There is an urgent need to reduce the use of chemosynthetic fertilisers and chemicals in agriculture for food crop production. In this context, the recycling and reuse of the annual hundreds of million tons of EU- wide generated agricultural and food waste streams contribute to safe products. One of the main goals of the new knowledge-based recycling technology is to recover and reuse phosphorous and nitrogen nutrient contents from organic waste streams. Their conversion into high-added-value products – the 'green carbon' biochar – as a soil improver and an organic phosphorous fertiliser is an important element of sustainability. The project applies a zero-emission pyrolysis technology. By providing high-mineral, organic phosphorous fertiliser and soil-improvers, REFERTIL is strongly supporting the interests of food safety and security. The most important element in this case is the recovery of pure phosphorous from the food-grade bone material, also known as Animal Bone biochar (ABC). Farmers as end-users will benefit socially and economically from the new applications.

### **The product: New waste procession technology, soil improvers and fertilisers as outputs**

The project's main outcomes are organic soil-improvers and fertilisers, the so-called bio-char. This green carbon product is a plant-based or food-grade, animal bone biomass by-product with a stable carboniferous substance. The safety

of the biochar product and legal compliance with the EU and Member States governments are of primary importance to the REFERTIL technology.

The bio-waste streams are processed in the absence of oxygen, under vacuum and at reduced thermal conditions. The plant-based biochar is used as a soil improver, whereas ABC is an organic phosphorous fertiliser providing nutrients to the plant. ABC is a high-calcium phosphate apatite mineral and a low-carbon content macroporous organic slow release fertiliser product. ABC is produced from food-grade category 3 bones between 600°C and 650°C by reductive thermal processing and negative pressure conditions. ABC is composed principally of carbon and hydroxyl apatite. This is the pure inorganic mineral building-block of natural bones, which are collected from food production at slaughtering and rendering processes. Thus, the input feed material does not to compete with human food, animal feed and plant nutrition supply. ABC can also be used as a highly efficient adsorber.



### **The end-users: Communities and public bodies, SME farmers, conventional agriculture, low-input organic farming, recycling industries, fertiliser producers, retailers and the horticulture industry**

REFERTIL biochar and compost products will reduce the negative environmental footprint of the cities and contribute to climate change mitigation. In this context, cities, communities and public bodies can benefit from the introduction of the new technology and market output biochar products on an economical industrial scale.

The potential clients of the industrial scale use of REFERTIL'S

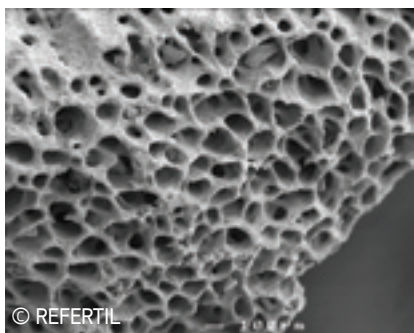
3R technology include recyclers, animal-waste rendering industries, the agro-chemical industry as well as the fertiliser industry.

The soil-improver and organic fertilisers can be used for daily applications by SMEs farmers as well as by plant breeders in horticulture and private gardeners. Supermarkets and retailers should also be aware of the product for end consumers. It allows safe food plant production with lower carbon footprints.

### **The inventors: Engineers, industry and communes**

The REFERTIL project applies 3R zero-emission pyrolysis processing technology. The method, as well as the industrial design, were single-handedly invented by Edward Someus (IPR owner), a Swedish environmental science and technology engineer whose core competencies are working with carbon processing, refining and utilisation.

The 3R is feed flexible. It can be successfully applied for added-value processing of different organic by-product and waste streams. The 3R basic idea, scientific and laboratory works have been there from the 1980s. The pilot plant scale-up engineering, implementation and testing was done in the 1990s. The next scale-up level has so far been industrial products like the field demo plant, constructed in 2003-2004 and co-financed by EU FP5. Since 2004, extensive 3R-application-oriented scientific development, industrial technology and EU-wide carbon-biochar product demo testing has been carried out under different EU co-financed RTD programmes, such as FP6, FP7 and CIP-Ecoinnovation. The project has reached full industrial scale by 2014.



The current REFERTIL consortium, consisting of 12 high quality partners from eight countries, addresses the improvement of the currently-used composting treatment and biochar-production processes with strong focus on the benefits to SMEs. For achieving the ambitious REFERTIL goals, qualified EU-wide collaborations were formed with external stakeholders who are connected to a world-wide REFERTIL network.

### **Development stage: Full-scale economic industry, ready for implementation of standard industrial capacity, licensing and technology transfer**

The first industrial biochar replication model was engineered and designed from 2010 to 2014. It is now ready for use and licensing and for technological transfer. The status of REFERTIL biochar has been proven and field-demonstrated in different climatic and soil field conditions and is ready for industrial implementation. It has now reached the status of completed post-development industrial-scale engineering and is being prepared for industrial licensing and technology transfer over the course of 2014 to 2015. The goal is the implementation of a plant that will process more than 20,000 tons of industrial-capacity throughput biochar per year. The standard capacity plant should be built in the EU or elsewhere worldwide and be based on this first industrial replication model, as an expanding business.

### **Policy impact: Biochar standardisation and law harmonisation**

REFERTIL is also providing policy support to the ongoing EU FERTILISER REGULATION revision. This proposed EU regulation includes law harmonisation on safe biochar and compost products by proven definition of high quality standards, maximum allowable limits and safe-application regulations. The goal is to reduce the use of mineral fertilisers and chemicals in agriculture. The REFERTIL quality criteria will contribute to best practice of production and supply of safe biochar and compost, while strongly supporting EU-wide bio-economical developments.

The REFERTIL criteria also provide a legal, technical, economic and market platform for sustainable biochar business operations, including an important legal element to support the users and consumers interest, such as the manufacturer's product responsibility, insurance and guarantee.

### **Next steps: Commercialisation, marketing and demonstrator plant**

The licensing and technology transfer of the proven industrial results are under progress on international level in 2014 and 2015. The ABC product has already been permitted. The commercial production-installation system is engineered and prepared for industrial implementation. Now, the market uptake for the output products is currently under evaluation.

Several industrial partners are in communication with the project. SME farmers in different countries working in a variety of languages have been made aware of the benefits of ABC. The marketing and dissemination of the economic, legal, business and environmental aspects of the biochar case is an important aspect of REFERTIL's work. As a new product, the global activity of biochar has existed mostly in an academic and science-based capacity so far. Therefore, strong marketing and dissemination activities are required. The first industrial and commercial biochar replication model will also support efficient knowledge transfer, including practical training to different stakeholders.



#### **REFERTIL**

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