



# 2014 Innovation Catalogue

Selected bioeconomy  
research projects



# About

With this second edition of the Innovation Catalogue, CommNet, the network to communicate the bioeconomy, continues the work of knowledge transfer to a wider audience interested in technology and business aspects of EU-funded research. Like in its first edition, this publication presents case studies from projects in the wide field of bioeconomy. The main objective of the Innovation Catalogue is to assess each project's innovation and market potential. The projects on innovative product and process developments are funded by the European Union's Seventh Framework Programme for Research (now subsumed into Horizon 2020). As this catalogue goes to print, Horizon 2020 is in the selection phase of new research and development proposals.

The twelve projects operate in three focus areas within the bioeconomy: blue and white biotech/ marine sciences, soils, water and fertilizers for agricultural primary production and the foodchain. Although at different levels within the innovation cycle and on different levels of technology readiness, they all represent remarkable examples of research with a high innovation potential.



Today, more than ever, the increased scarcity of resources, constant population growth and the threat of global warming impel Europe to seek new solutions to tackle the main societal challenges. Innovative biobased products from farmland, sea, forests and biorefineries have the potential to change challenges into opportunities while contributing to sustainable and inclusive growth, jobs and competitiveness as set out

in the EU 2020 strategy. With technological expertise, new products and processes, service applications and social innovations emerging from EU-funded projects, research is one of the uncontested sources of public and private wealth in the European Union. Today, the bioeconomy and its various sectors already employ over 22 million people in Europe and represents turnover of over EUR 2 trillion per year. Bioeconomy innovation aims to reduce risks, maintaining and improving product quality, increasing yields while reducing inputs.

Innovation can be seen as a cyclical process: a linked chain of research, development and management. This cycle includes a number of stages measuring the technology readiness levels (TRL) of a development. The project's self-assessment of its position upon the stairway of the TRLs builds a necessary prerequisite for cooperation between science, industry and other stakeholders.

To bring together research, industry and business in Europe – and to overcome the still existing European paradox which is reflected in the gap between the full plethora of excellent research and yet few products which can maintain their relevance on the marketplace – much more effort must be made to support researchers and their results along the entire innovation cycle. This support starts with better communication between the worlds of science, technology development and business – each with different views on the goals and exploitability of research and development. In order to start this flow of communication on innovation in the bioeconomy, coordinators and communication officers of selected projects have provided the descriptions of their case studies featured in this catalogue. This publication has been edited by a CommNet consortium member, the Brussels-based communications agency PRACSIS, specialised in communication strategies and in research and innovation policy.

The Innovation Catalogue 2014 facilitates interaction between showcased projects and technology transfer experts, business developers and representatives of the industrial and commercial sectors as well as SMEs in the field of bioeconomy. Contributing to the dissemination of research results, the CommNet project bridges the gap between research and industry in order to encourage inclusive and sustainable innovations in the bioeconomy.

Brussels, June 2014

# What's in ?

## BLUE AND WHITE BIOTECH/MARINE SCIENCE

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### BAMMBO

BAMMBO researchers have invented a sponge milking factory to extract the bioactive compounds of cultivated sea sponges with a huge potential for drugs and antimicrobial substances. The new process maintains a continuous supply of huge amounts of sponge tissue by avoiding the destruction of biomass. The "factory" delivers a yearly production of several grams of purest compounds produced by marine sponges – ready for take-up by bio processing companies.

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### BIOSURFING

Yeast can be the cell factory of the future, once the biosurfactant products from BIOSURFING enter the markets. The project is shaping bio-based platforms for an eco-friendly chemical production of detergents in cleaners, wash powders, polishes and other applications on novel yeast-basis to alleviate the dependency on the non biodegradable petroleum based chemistry.

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### DIVERSIFY

Marine scientists identify in the project DIVERSIFY a number of new and emerging finfish species, with great potential for the expansion of the EU aquacultures. DIVERSIFY looks for fast-growing fish which can be marketed in large volumes and in new convenient fish products for consumers.

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### PARASITE

To enhance safety of marine food products, the PARASITE project developed new methods to monitor and to detect parasites and allergenic substances in seafood. Since international markets grow, since the food chains are globalised and supported by quick transportation systems, fishery-product-borne zoonoses are on the rise. The project's focus spans from epidemiology to risk assessment and impact-mitigation through innovative detection methods.

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### PHARMASEA

New drugs, new ingredients in food and cosmetics will soon come from the deep sea. The project PHARMASEA brings European researchers to some of the deepest, coldest and hottest ocean places on the planet where they collect and scan marine microorganisms. Their main goal: to discover and shape new antibiotics and pharmaceuticals to counter diseases of the central nervous system.

## FOODCHAIN

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### HEALTHBREAD

Naturally enriched bakery products - rich in fibre, crisp and crunchy – will be rolled-out to markets as innovative results of the project HEALTHBREAD. Craft and research together have optimised traditional products towards health by using advanced milling technologies, dedicated dough fermentation and optimised baking processes. In an unique cooperation of eight SME bakeries from four European countries, scientists and industrial partners together developed the innovative white bread and whole grain products which are currently being tested by consumer groups.

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### INSIDEFOOD

The 3D-visualisation and measurement of microstructures of cereals and dry fruit are at the centre of the technology developed in the INSIDEFOOD project which aims at quality improvements for the food industry. But not only the texture of processed food can be better controlled, the micro-structures of fresh and dried fruit are also subject of a closer inspection by the INSIDEFOOD instruments in order to identify foreign content, bitter pit, core browning or water cores.

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### PERFORMANCE

A new and tasty molecular cuisine for elderly and frail persons is the aim of the PERFORMANCE project. Jellylike convenient food products are manufactured in a 3D-printer, frozen and delivered to people with mastication and swallowing problems. The high-tech manufacturing of high quality food in the PERFORMANCE concept can help provide a personalised and attractive dishes to persons in care or at home.

## SOIL & WATER & FERTILIZER

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### FIGARO

The FIGARO system is for farmers and growers. It collects and integrates environmental and local crop data from sensors, prediction models and remote imaging in order to provide accurate, precise and reliable recommendations for irrigation. On the basis of a seven-days plan, the system tells farmers when and how they should irrigate their crops, using a simple interface. FIGARO's result is a user-friendly yet sophisticated DSS (decision support system) and software producers.

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### OPTIFERT

The technology developed in OPTIFERT aims to deliver tailor-made irrigation and dosage of fertilizers simultaneously with high-tech solutions through "fertigation". Soil sensors, dosage units and new software will help farmers and farmer advisors to achieve better yields, environmental protection and resource efficiency. All modules have been developed to prototype stage.

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### REFERTIL

A knowledge-based technology for the emission-free production of biofertilizers and soil-improvers has been developed and will be marketed soon by the REFERTIL project. Through a pyrolyze thermic process, REFERTIL converts agri-waste streams and by-products of plant and animal origin into high-value green charbon, the bio-char fertilizer product allowing safe crop- and food production on healthy soils. The implementation of a plant for processing >20,000 tons/year of organic phosphorous fertilizer biochar is envisaged.

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### TREAT&USE

Precise irrigation with treated waste-water technology: the TREAT&USE project brings forward innovative and safe waste-water treatment systems for irrigation in agriculture and horticulture, especially for regions with water scarcity in rural and peri-urban areas. A membrane bioreactor (MBR) has been designed to contain plant nutrients in waste water while pathogens are killed, a fertigation station mixes water with fertilizer, sensors are monitoring and controlling nutrient contents of soils and feeding the irrigation process with precise information.

# BAMMBO: A SPONGE-MILKING FACTORY

The blue growth project aims to retrieve the many bio-active compounds of sponges in a sustainable manner

## The project: Sustainable production of high-value-added marine bio-molecules

Our increasing knowledge of marine biodiversity has recently revealed a high economic potential associated with biomolecular organisms such as algae, fungi, sponges and marine-bacteria produce. While several marine products have already found a market mainly in the nutraceutical, cosmetic and pharmaceutical sectors, the main bottlenecks that hamper their use on a large scale is without doubt the issue of supply. In this context, the blue growth project BAMMBO, funded by EU FP7, seeks to find innovative alternatives for the sustainable production of marine high value-added biomolecules. Over 500 marine fungi and bacteria were studied in the project; and a range of new bacterial enzymes could be isolated. Macroalgae showed great potential in antibacterial properties, as well as in antitumour and anti-inflammatory properties. The Irish SME partner focussed on the extraction of high value compounds from green microalgae with emphasis on astaxanthin, which can provide protection against UV light and act as an immune-response aid.

The partners from the Mediterranean region are dedicated to finding sustainable alternatives to the common chemical synthesis for the production of sponge molecules. Their approach was based on sponge aquaculture, for which the project sought economic and sustainable culturing methods, a process called mariculture. Moreover, the project demonstrated and developed 'sponge-milking' – a new process which focuses on the extraction of compounds while avoiding the destruction of biomass.



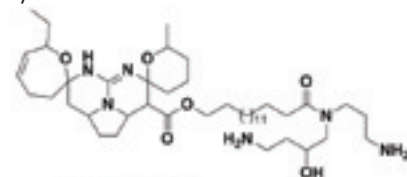
The research results on sponges and related processes will facilitate wider access to the chemical diversity produced by sponges. Sponges are one of the most prolific sources of structurally complex compounds with anti-pathogen properties and anti-fouling agents but are highly difficult to cultivate. A sponge-chemical library has been set up and is accessible to all industries and academic entities.

## The product: A new process and pure sponge compounds

Because one of the obstacles to extracting natural compounds is the difficulty in maintaining a continuous supply of huge amounts of sponge tissue, the project emphasised the discovery of new and sustainable processes that avoid the destruction of the biomass. The sponge-milking factory is a direct product of the BAMMBO project. This new and sustainable process allows the yearly harvesting of several grams of pure compounds produced by marine sponges. The method has been applied successfully to several species of sponges. It has proven very efficient for encrusting sponges, and it is also possible to produce compounds from erect branching sponges and massive sponges, though yields are lower.



*Crambe crambe*



Crambesidin 800

## The end-users: Industry, health professionals, consumers, policy makers and legislators

From an industrial perspective, the project outputs are of great value for bio-processing companies, pharma, and the cosmetics industries, as well as for health and care professionals and the consumers of the sponge-derived compounds.

As the derivatives found: legal and field or clinical testing, it would be of interest to regulators and legislators deciding which project outputs will enter the market and may be subject of the future drug and health product legislation.

## Development stage: Proof of principle, up-scaling, piloting

The proof of principles of this process, sponge-milking, has been



demonstrated for three species and we are now able to offer between one and ten grams of pure sponge compounds each year for all kinds of applications. A patent will be associated with the automated version of this process in late 2015.

Several compounds have already been shown to exhibit interesting bio-activities like antimicrobial and antitumour activities.

We then propose to research the wide chemical diversity of sponge molecules. We will begin with small quantities (between one and ten milligrams) to assess their potential and larger quantities after that (between one and ten grams) to confirm their economic value. We will address industries concerned with original and natural ingredients, to discover their interest in the sponge-derived compounds. Prices will vary for each sponge product, as sponge aquaculture is highly variable according to the species cultivated.

### **The inventors: Academics, technology-transfer organisations**

With the help of national but also regional funds, researchers of the University of Nice started to build a library of sponge products coming from the Mediterranean in 2007. The EU-funded BAMMBO project helped to develop the sponge-milking factory on a small scale between 2011 and 2014 and subsequent financial support was provided by the Société d'Accélération de Transfert de Technologie Sud-Est, allowing us to scale up this process to reach quantities exceeding 1g of pure compound per year.

### **Policy impacts: SME and job creation, raising competitiveness, new protection rules**

Our sponge-milking factory will open a new perspective in the aquaculture of marine invertebrates for the development of the molecules they produce. A large array of applications will derive from this process and local jobs are expected to be the main result of this new and sustainable approach. Of course new legislations on this original aquaculture will be required to ensure the protection of the marine environment.

### **Next steps: Spin-off and market analysis**

The BAMMBO-project came to a close in spring 2014. As consortium partners who want to go further, we have already had the support of technology-transfer experts in the South of France to scale-

up but also to conduct a market analysis. Now we are ready to build a spin-off company. To begin, we need advice for the construction of this company. Therefore:

- We would like to be involved in networks of marine-biotech companies sharing expertise in aquaculture and marine products.
- We then need access to all possible clients of these sponge products, whether in the private or public sectors.
- We wish to apply our process to species from other regions of the world and then to collaborate with other countries.
- We are finally ready to cooperate with marine engineers for the development of the automated process that will render our process more robust.

At the end of 2014 this sustainable process will be implemented by the SeaRena cooperative, which will offer easy global access to the sponge-chemical library, but also to the sponge-milking factory.



#### **BAMMBO**

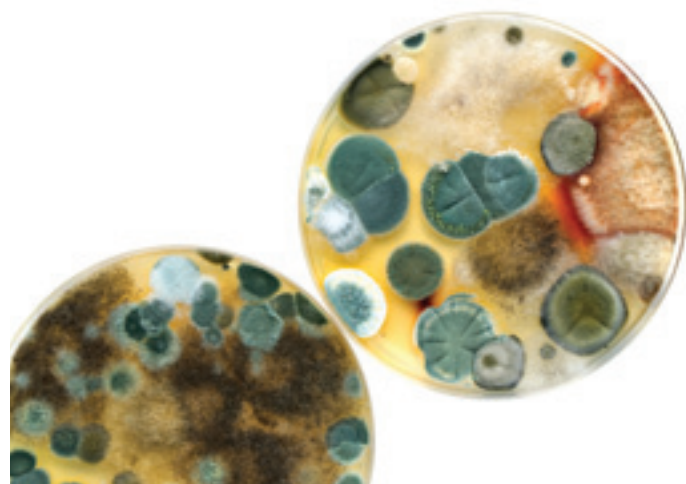
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# ECO-CLEANERS, GREEN COSMETICS AND BIO-ACTIVE MEDICINE

## BIOSURFING – How new yeasts will boost our everyday chemicals

### **The project: Shaping bio-based platforms for an eco-friendly chemical production**

Laundry and household cleaning are facilitated by tons of chemical helpers. They are the agents in our cleansing liquids, wash powders, foams and rinsers. These chemicals, called surfactants or surface active agents, help to make dirt and fat soluble and to keep cleansers smooth or stable. But such chemical all-purpose weapons are not only good for households, they are also applied in oil recovery, and in the agricultural, paper and pharmaceutical industries. Industrialisation would not have happened without these multi-taskers. Their big disadvantage, however, is that the majority are still based on petroleum and are in some cases eco-toxic, damaging water and soil because of their non-biodegradability. Currently, the world annual surfactant production exceeds 13 megatons, with rising trends in the emerging markets of Asia, South America and Africa. As our environmental concerns deepen, ecologically friendly materials gain more global interest.



The EU-funded project, BIOSURFING, therefore found a promising target in the bio-based economy by exploring paths to produce these surfactants in plant-based ways – through molecular-engineered yeasts and the yeast-fermentation of sugars and vegetable oil. Before the green chemicals reach the market, the researchers need to overcome several natural barriers. The overall use of bio-surfactants is hampered by the lack of structural variation. This is in sharp contrast to chemically produced surfactants, which contain a lot of multi-purpose building-blocks, called structural variants. While the

petroleum-based surfactants introduce variation by simply changing the building blocks and can easily be converted into a myriad of different products, the bio-based surfactants are limited in their range. The BIOSURFING project aims to alleviate this fundamental limitation by developing a generic bio-technological production technique for glycolipid bio-surfactants. The BIOSURFING project intends to achieve this by using novel, molecularly engineered yeast strains. These will lead to new product properties, suitable for multi-purpose applications in households, factories and labs.

### **The product: Cleansers, foods, cosmetics, drugs and nano-particles**

The good biodegradability of tailor-made eco-cleaners, bio-based painting materials, polishes, green-wash and cleansing emulsions will turn out to have a real advantage over bio-based bulk chemical production. Soon EU legislation will ask for more eco-friendliness in the entire production cycles. BIOSURFING provides the building-blocks with its novel yeasts.

Bio-surfactants will be compounds in cosmetics, foods, textiles and pharmaceuticals – they intervene practically in nearly every product and every aspect of daily life.

Certain bio-surfactants can also be used for anti-microbial and anti-fungal purposes in agriculture and in plant protection. The immunological properties or inducers of cell differentiation can be applied in pharmaceuticals and bio-medicine. Nano-materials and ceramics can be composed of bio-surfactants.

### **The end-users: Players in the production and consumption of bio-surfactants**

Biochemical industry will most benefit from the process development which offers new molecular-engineered yeasts and process platforms for bio-refineries.

Industrial compound producers for bulk chemicals and fine chemicals will be the clients of the future patent-holders.

Agriculture chemical industry and manufacturing industries will use applications of bio-surfactants on many levels, such as composition of products, protection and finish of surfaces, and the cleaning of machinery and buildings.

Retailers and consumers will see the new eco-friendly products in green mass-markets of chemical household goods, cosmetics, pharmaceuticals and other applications.



It is expected that this technology will result in a breakthrough penetration of glycolipid bio-surfactants in the overall surfactant market, and will help to build the bio-based economy in this way.

### **The inventors: Academics, SMEs, industries**

The project aims to create new-to-nature and tailor-made bio-surfactants through metabolic engineering of the unconventional yeast *Starmerella bombicola*.

The main objectives of the BIOSURFING project can be divided into three main interacting parts: (1) strain development allowing control over all structural parts of the glycolipid bio-surfactant, (2) development of a production and purification process, (3) application evaluation in cleaning and cosmetics, medics and nano-science. The project thus covers the whole innovation chain from basic research to production and application development.

The Centre for Industrial Biotechnology and Biocatalysis at Ghent University coordinates the consortium. Together with the three academic partners in the project (University of Ulster, UK; University Pierre et Marie Curie, France; Ghent University, Belgium), five industry and SME partners are collaborating (Bio Base Europe Pilot Plant, Belgium; Celletics, France; Werner & Metz GmbH, Germany; Cosmetic sp. Greece; Ecover, Belgium).

IPR-securing actions and patenting will be ensured prior to commercialisation of envisaged processes and products.

### **Development stage: Up-Scaling and piloting**

Molecular engineering and development of new strains in yeast *Starmerella bombicola* has been done.

Downstream processing procedures for the new-to-nature glycolipid bio-surfactants are being developed.

Demonstration and scale-up of developed fermentation at 25000 l scale is envisaged.

Samples of new bio-surfactants: supply of gram-to-kilogram sample material planned.

### **Policy impact: Eco-friendly daily lifestyles, new EU regulations and feeding the GMO debate**

The project BIOSURFING clearly contributes to the lead-market initiative for bio-based products, and in overall terms to the Europe 2020 strategy for sustainable economic growth.

The new-to-nature bio-surfactants will meet the requirements of the altered chemical products regulations such as the REACH legislation for novel bio-based products (easier, cheaper, introduce subsidization). The novel products will contribute to a more competitive and eco-friendly European industry.

BIOSURFING and the resulting application also feed into the discussion about GMO use and the need to solve societal challenges.

### **Next steps: Feasibility assessment, evaluation of applications, marketing**

Samples will be evaluated by various companies and in various applications. Economic feasibility studies of processing will be carried out, exploratory marketing will prepare for commercialisation.

Licensing processes will ensure that the novel compounds will be used in real-life products or applications on European and global markets.



#### **BIOSURFING**

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# NEW FISH TO FEED THE WORLD

DIVERSIFY identifies the potential of new species for fish farming

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## The project: Knowledge on new or emerging finfish species for European aquacultures

Fish farming has become an important factor in the provision of protein worldwide. Aquaculture is already delivering two to six million tons of seafood every year, by increasing rates. Therefore DIVERSIFY's main objective is to acquire the necessary knowledge for the diversification of European aquaculture production based on new and emerging finfish species.

Already the project has identified a number of promising new and emerging finfish species for the expansion of EU aquaculture. Although the emphasis is on Mediterranean cage-culture, fish species suitable for cold-water, pond culture, extensive culture and intensive fresh water aquaculture have been included as well. These new or emerging species are fast growing, and they can be marketed on a large scale. Their inclusion in a range of products could provide the consumer with both a greater diversity of seafood and new, better value food products.

Species-specific husbandry and technological protocols, new products and business models and marketing methods developed within DIVERSIFY will provide the insight for industry expansion and the means for diminishing the dependency of the EU on imported fish products. The European aquaculture industry is presently struggling to satisfy their clients' and consumers' demands. The knowledge to produce and effectively sell, alternative fish species is sought by the industry.

Most companies produce only one or two species, making them extremely vulnerable to the boom-and-bust cycles that periodically hit the aquaculture industry. However, producing a new species involves a large and risky economic investment for a company. For this reason, the results of DIVERSIFY will also address all predicted bottlenecks and offer maximum certainty for the producers that could take on this challenge. Another important innovation considered in this project is the analysis of the aquaculture-production business model as a whole.

## The product: New species, new fish products, less dependency on imports

The target fish species of DIVERSIFY are as follows: meagre (*Argyrosomus regius*) and greater amberjack (*Seriola dumerili*)

for warm-water marine cage culture, wreckfish (*Polyprion americanus*) for warm and cold-water marine cage culture, Atlantic halibut (*Hippoglossus hippoglossus*) for marine cold-water culture, grey mullet (*Mugil cephalus*) a euryhaline herbivore for pond or extensive culture, and pikeperch (*Sander lucioperca*) for freshwater intensive culture using recirculating systems. The technologies for producing these selected species will be improved through DIVERSIFY.

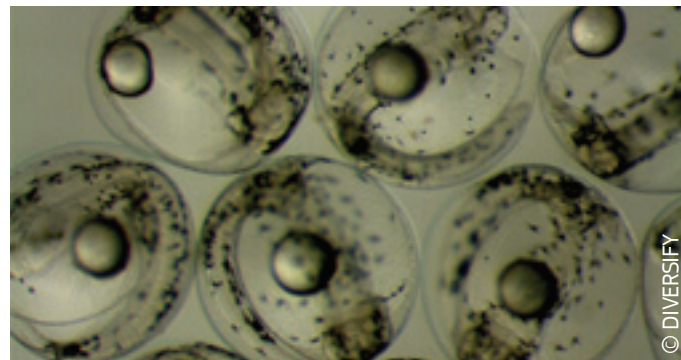
Some of these species are already being produced to a certain extent and have great potential for expansion, while for other new species more research is required. DIVERSIFY will provide the tools and develop new production technologies for fish producers to increase the variety of fish species suitable for the aquafood market.

Moreover, one of the main objectives of DIVERSIFY is to improve marketing of processed fish products (fillets, smoked, battered 'fish finger' type products, ready-to-eat meals and other value-added products). The project thus is also expected to identify the bottlenecks in markets and help to alter consumer perception and consumer preference.

This integrated combination of biological, technological and socioeconomic activities will lead to less imports from non-EU countries with questionable health, environmental and social standards for farmed fish production.

## The end-users: Aquaculture farms, fish processors, fish-feed companies, wholesalers and retailers, consumers

DIVERSIFY will lead to a greater diversification in fish breeding and to an enhancement of production volumes. Prime partners of the project are aquaculture companies and their related aqua companies (feed supplier, equipment suppliers, etc).





Further developed processing of fish will lead to new fish products, new deep-freeze products, ready-to-eat meals and protein snacks, for which the diversified supply of new fish can deliver appropriate ingredients.

In this regard, retailers play a much stronger role in forming consumer preferences and are an indispensable link between producer and consumer.

### **Development stage: Biological research, selection, studies**

The research areas are: genetic and reproduction, nutrition, larval husbandry, grow-out husbandry, fish health and socioeconomics.

Expected outcomes of the project are proof of principle and concepts:

An analysis of macro-environmental and micro-environmental (competitive) factors that influence supply and demand in the aquaculture production chains in general, and the chains of the considered species that are currently in production (meagre, halibut, pikeperch and mullet) or are supplied by capture fishery (wreckfish and greater amberjack). This analysis will define the opportunities and threats for product development.

A feasibility study will explore the market expansion, market development and new-product marketing strategies.

Wide dissemination of this information to key stakeholders (aquaculture personnel, producers, retailers, industry and consumer groups).

The development of a long-term business plan for market potential of each species.

### **The inventors: Academics, SMEs, industries, professional associations**

DIVERSIFY is a consortium of 20 RTD organisations, nine SMEs, three large enterprises and six professional associations, coming from ten EU countries and including two non-EU members, Israel and Norway.

The consortium covers a wide geographic area working with different fish species. The project also aims to create an extensive dialogue between researchers on the one hand, and aquaculture breeders, producers, retailers and aquaculture feed producers on the other.

### **Policy impact: Legislation and certification**

Effective communication with policy makers and standard bodies will also be very powerful and beneficial for the industry. One of the project's specific objectives is to perform an assessment of the obstacles for growth in current aquaculture production. These analyses will be provided to the corresponding authorities. The aim is for the creation of new insights into the level playing field of the selected species in relation to wild fish and similar species from other world-regions.

Moreover, a certification framework for the species addressed in DIVERSIFY will be proposed to the public bodies.

### **Next steps: Marketing campaigns, talks with retailers to offer more variety**

As a result of the research, new policy and strategy recommendations will be available for the market expansion of the sector. At the same time, European fish processors are

presently touring the world in search of fish, be they wild or farmed. Providing a new source of quality fresh fish produced at the right price and suitable for efficient processing should attract interest from the European aquaculture market. Except for Atlantic salmon, which is used in a wide range of processed products, the rest of EU aquaculture fish are sold mostly as whole fish, which limits the shelf-life and the product range offered to the markets. Better transfer of knowledge to retailers is therefore a must.



**DIVERSIFY**

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# FISH AND SEAFOOD – ALL SAFE, ALL GOOD

More transparency and safety-tools for fishermen, consumers, importers and distributors of fishery products through PARASITE

## The project: Monitoring marine food, detecting sicknesses, securing value chains

Safe fish and seafood, free of risk, is in the interest of all consumers of sea and water-products. Apart from safety risks for consumers of marine food, parasites destroying the quality of the fishery products represent a substantial economic threat for the seafood industry. The researchers from the PARASITE project go out on their boat to the sea in order to look at the origins of fish-borne parasites, and at the light tables in their laboratories they explore methods for better seafood safety.



In 2010 scientists working on Biological Hazards Panel (BIOHAZ) of the European Food Safety Authority (EFSA) published a report identifying several risks of parasites in fishery products. The EU fishing industry is one of the largest worldwide. Consumer trust and quality perception is of crucial value for the industry. Since international markets grow, since the food chains are globalised and supported by quick transportation systems, fishery-product-borne zoonoses are on the rise, with extended geographical limits and populations at risk coupled with demographic changes. The EFSA therefore asked for the improved collection of systematic data on the complete life cycle, geographical and seasonal distribution, prevalence, intensity, anatomical location of parasites in wild-caught fishery products, infectivity and inactivation treatments and methods. The PARASITE project tackles the problem from epidemiology to risk assessment and impact-mitigation alternatives.

## The product: Detecting methods, mitigation and data banks

Three technological products, well advanced and soon to be industry applicable, can be presented now.

The UV press detection method: this method is particularly useful for detecting nematode larvae in fish flesh in the processing

industry. It consists in the observation of pressed and deep-frozen fish fillets (or viscera) under UV light. The fluorescence of frozen anisakid larvae allows their visual detection and quantification. Although this method is currently being used in large scientific surveys, the automation of the pressing and larvae detection steps are being carried out to make it more efficient and user-friendly. This is a simple, accurate and cheap technique; characteristics that may contribute to its adoption as the routine inspection method.

The RT-PCR detection method: this detection method is particularly useful for detecting the presence of parasite traces in highly processed fishery products. The molecular method consists of a RT-PCR<sup>1</sup> assay targeting the mitochondrial cytochrome oxidase II (mtDNA cox2). Although the presence of traces of anisakids DNA does not represent a risk for most consumers, highly sensitised citizens may benefit from this rapid technique. It allows the detection and identification of anisakid nematodes to species level, even at a low concentration of DNA.

The mitigation method: we have developed an electronic device to treat offals on board in order to minimise the reintroduction of viable parasites to the environment. The gutting and discarding of viscera on board is an extended practice in all European fisheries. This practice represents a way of reintroducing viable parasites to the environment, which may increase the parasite infection levels in wild fish. Within the project, the device to inactivate these larvae by using electronic radiation is being developed.



The Biobank: To improve the fisheries' management of systematic monitoring programs, the collected samples and the related data are stored and managed in a sample Biobank. This innovative tool will lead to a computer-aided epidemiological, geo-referenced database for zoonotic parasites in fish stocks and products marketed in Europe.

### **The end-users: Food inspectors, fish and seafood industry, policy makers, consumers**

Our project outcomes mainly focus on food-safety authorities as well as the fish and seafood industry, including fishermen, processors, importers and distributors.

Policy makers, food safety authorities, fishmarketers and seafood-market managers will be enabled to take better informed decisions.

From a wider point of view, consumers may benefit from the reduction of risk exposure.

### **The inventors: Academics, research institutions and SMEs**

The PARASITE project has 21 partners, 15 RTD performers and 6 SMEs from Europe and Asia.

Regarding the three technological products presented here:

UV press method: it is based in a prior methodology developed by Karl and Leinemann in 1993. The work developed within the PARASITE project will be focused to improve this technique in order to mechanise the press and detection of larvae steps. Viability determination will be included as an asset. This work is being carried out by CSIC-IIM, NIFES, MRI and TechNet, all consortium partners.

RT-PCR methodology is being developed by UT-URS team, based in their previous works on this topic.

The device to treat offals on board is being developed by CSIC-IIM and ARVI. This device is an improvement of a prototype developed within a previous project in which CSIC-IIM was also involved.

### **Development stage: Technology transfer, pilot stage of tools, industrial up-scaling**

Different detection methods will be validated in laboratories and tested on an industrial scale. As a result, sensitive, specific, accurate and industrially applicable methods will be obtained, which can be recommended as the routine detection method by food safety authorities and industries.

### **Policy impact: A better food safety policy and enhanced competitiveness**

PARASITE aims to support the European Food Safety Policy. This way, the project will yield the basic information and technological tools to facilitate the implementation of strategies that can mitigate the problem of fish parasites. Concerns about food allergies are increasing worldwide and those industries capable of producing a completely safe product may have a competitive advantage. As part of the project, the willingness to pay for parasite-free products will be analysed, providing new data on consumers' preferences.

### **Next steps: Feasibility studies, beta-tests, industry workshops, new research roadmaps, communication**

To raise the impact on food safety policy, a permanent dialogue with food safety authorities was started through the European Reference Laboratory for Parasites and other national and European agencies.

The implementation of tools at industrial level is partially guaranteed by the involvement of industrial partners in the project. Moreover, intensive technology transfer was developed within the project. This way, workshops targeted to the industry will be organised as well as short-term stays for people from the industry in RTD facilities.

A beta-testing exercise on detection methods will be carried out by the industrial partners to check their implementation feasibility.

Our communication strategy will use different media channels to reach a wide audience and to help the PARASITE consortium become a reference for the topic of fishery-products-borne parasites. The outline of an action plan and cost-benefit scenarios will be elaborated on.



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#### **PARASITE**

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# DEEP DOWN THE OCEANS BLOSSOM AND OFFER A SEA PHARMACY

The PHARMASEA project reveals blue treasures: globally collected marine bio-resources for new drugs, cosmetics and nutraceuticals

## **The project: Discoveries in the marine bio-pipeline**

New antibiotics and new ingredients for food and cosmetics will soon come from the deep sea. In the PHARMASEA project scientists from the UK, Belgium, Norway, Spain, Ireland, Germany, Italy, Switzerland and Denmark are working together to collect and screen samples of mud and sediment from huge, previously untapped oceanic trenches. Once the samples are collected, the new fungi and bacteria are grown in labs, genetically screened and processed. The PHARMASEA project hopes to show the value of marine bio-resources to the discovery of new pharmaceuticals. In particular, the consortium investigates marine microorganisms that live in deep and cold oceans, for their potential to produce new antibiotics and pharmaceuticals for diseases of the central nervous system such as epilepsy or Alzheimer's disease.

## **The product: Drugs for neurological, inflammatory and other infectious diseases**

The discovery of new pharmaceuticals is the main deliverable from the PHARMASEA project. It will generate a large amount of knowledge about microorganisms that dwell in extreme environments, as well as their potential to produce novel chemical entities. Bacterial diversity within sea sponges may also open a new universe of potential applications. Moreover, marine organisms that live more than 6,000 metres below the sea level are considered to be an interesting source of novel bio-active compounds as they survive under extreme conditions. Deep under water, the sea blooms, the researchers tell us.

One of the aims of PHARMASEA is to discover new marine bacteria that can produce novel antibiotics to fight the growing challenge of antibiotic resistance. There's a real lack of good antibiotics in development at the moment. There hasn't been a completely new antibiotic registered since 2003. If nothing's done to combat this problem we're going to be back to a "pre-antibiotic era" in around ten or twenty years, where bugs and infections that are currently quite simple to treat could be fatal,' says Marcel Jaspars, scientific leader of the project and Professor of Chemistry and Director of the Marine Biodiscovery Centre at the University of Aberdeen. PHARMASEA will also focus on drug discovery for neurological, inflammatory, and other infectious diseases. With this, chemistry with new activity will be established.

An extract library is being created during the project. This can offer new pathways to researchers and end-users.

To make the process of marine bio-discovery attractive to industry, the project will address the bottlenecks that are preventing greater industry uptake of marine bio-technology. The main challenges lie in purification and pharmaceutical testing of toxicity and bio-activity. PHARMASEA applies stringent filters to obtain only the highest quality marine resources and uses state-of-the-art methods to speed up the technical parts of the bio-discovery pipeline.

## **The end-users: The pharmaceutical industry, medical research, clinics, personal care, food producers, processors, consumers**

The entire pharmaceutical and nutraceutical value chain from industry to consumers can be envisaged as potential clients. PHARMASEA's goal is to deliver one or two drug candidates in the near future with some pre-clinical evaluation carried out on them.

There is a critical need for these compounds, recognised in the Infectious Disease Society of America's influential report 'Bad Bugs, No Drugs', which led to the proposal of the 10 x 20 initiative – ten new antibiotics by 2020. The current market model for antibiotics is broken and this can be fixed by new economics (much higher prices for antibiotics) or by



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public-private partnerships involving, as in our case, a blend of universities, research institutes, not-for-profit organisations and SMEs.

In addition, diseases of the central nervous system are currently poorly served, which is why the sea pharmacists are searching for better treatments for epilepsy and neurodegenerative diseases.

The estimated market value of the sea pharmacy is estimated at several billion euros.

### **The inventors: Academics, research institutions, industries**

The collaborative PHARMASEA project builds upon a highly interdisciplinary consortium of 24 partners from 13 countries from the fields of industry, academia and non-profit organisations. World-leading experts from Belgium, UK, Norway, Spain, Ireland, Germany, Italy and Denmark as well as partners from China, South Africa, Chile, Costa Rica and New Zealand are taking part in the PHARMASEA project. PHARMASEA brings together researchers from the areas of marine genomics, bio-synthesis and chemical-structure analysis, as well as legal experts. The international team of scientists is led by Professor Marcel Jaspars of the University of Aberdeen in Scotland, and coordinated by Dr Camila Esguerra of the University of Leuven in Belgium.

The project partners have broad expertise in almost every area of the pipeline. They offer SME/NFPs in antibiotic discovery academic, and SME, expertise in molecular genetics and heterologous expression, the capacity to produce at scale, and expertise in natural-product isolation and structural identification. One partner provides world-beating data-mining and chemical software capabilities.

Several members of the project are part of several consortia, most notably Macumba. They cooperate with the projects BLUEGENICS and SEABIOTECH on legal/policy aspects as well as dissemination. The PHARMASEA research is committed to the long-term maintenance of samples via OPENSREEN and of data via ChemSpider.

### **Development stage: Proof of principles, up-scaling, optimisation of fermentation processes**

The primary aims of the project's business focus, are to take forward bio-active compounds and to evaluate their potential as new drug leads or ingredients for nutritional/cosmetic applications, including up-scaling and optimisation of the fermentation process beyond 1L to 20L.

So far, the researchers have analysed the entire marine bio-discovery pipeline and identified the bottlenecks. State-of-the-art solutions for each of these will be provided. The goals are to deliver one or two drug candidates.

For instance, access to really deep water is restricted by lack of access to oceanography ships and deep-sea sampling equipment. The project's fix for this is to develop inexpensive and robust equipment based on that developed for the salvage industry. The researchers will use other scientific and technical fixes to optimise the discovery process of novel microorganisms and the mining of their genomes.

### **Policy impact: Improved bio-discovery processes**

One of the main barriers to the greater uptake of marine bio-discovery is access to samples, as there are multiple legal regimes that apply to the collection of marine bio-resources. The project's work on access to marine genetic resources with legal certainty has been very successful. They have advised policy makers, convened a panel of experts from the EC, NGOs and academia, and have published an advisory article on legal regimes applied to the use of marine genetic resources. PHARMASEA will add to that an article explaining the marine bio-discovery process to policy makers and a user toolkit to allow marine bio-discovery researchers to navigate the legal regimes necessary to access marine genetic resources with legal certainty.

### **Next steps: To develop lead molecules and attract the pharma industry**

The next step is to develop any lead molecules found for pre-clinical and then clinical evaluation. For this we will need to licence products, or co-develop them with industry.

Getting the pharmaceutical industry interested in the results of the project is complex, 'however, we have had discussions with major pharma and have invited them to the open part of the PHARMASEA general assembly in September this year to hear the latest results from the PHARMASEA project,' says Camila Esguerra, pharmacist at the University of Leuven and project coordinator. She continues, 'We have had positive responses to this, and by doing this we hope to have a dialogue with companies so that any successful products from PHARMASEA can be co-developed.' The project will also provide asset notes to explain important results which might interest industry. This will be a way to communicate with potential end-users. Potential end-users can get involved with PHARMASEA by contacting the scientific project leader, Marcel Jaspars.



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# OUR DAILY BREAD – REVAMPED

HEALTHBREAD: Naturally-enriched bakery products are good for consumers and SMEs in Europe

## **The project: Developing new bread products by applying advanced milling technologies, dedicated dough-fermentation and optimum baking processes**

All over Europe the actual intake of dietary fibre is substantially below the recommended level of 25 to 35 grams per day for adults. Research over the last decade clearly indicates that the dietary fibre of whole grains, together with its closely associated minerals, vitamins and other beneficial compounds contributes to health. In recent dietary recommendations, cereal fibre is therefore considered a preferred source of fibre. A major shift from white to wholegrain bread would contribute to lowering the incidence of non-communicable diseases such as colon cancer, heart diseases, and type-2 diabetes.

However, most Europeans prefer the mild taste, soft crumb and crispy crusts of conventionally-processed white bread. Here, the EU funded project, HEALTHBREAD, steps in. This FP-7 project further develops the results of the predecessor project, the FP-6-funded HEALTHGRAIN project. Its goal is to produce bread products high in fibre and other bio-active compounds from grain, whilst retaining the desired sensory attributes.

The bio-active compounds are concentrated primarily in the bran and in the germ of the grain. Advanced milling technologies obtain wheat fractions high in fibre, minerals, B-vitamins and anti-oxidants and include properties such as light colour and mild taste. To improve the bio-accessibility of the bio-active compounds, long yeast fermentation processes ('slow food', 'bio-processing') are introduced. Major anti-oxidative and anti-inflammatory effects can also be reached by optimising the fermentation of the wheat fractions. Consumer demands for healthier bread options are driving these new product developments. SME bakeries can quickly adapt to these changes since HEALTHBREAD will deliver business plans to successfully market naturally-enriched bread products with the desired properties such as high volumes, crumb softness, light colour and great flavour.

## **The products: Fibre-rich bread loafs and rolls, easy to digest and tasty**

Ensuring product-quality, safety and consistency across multiple scales, HEALTHBREAD products go beyond standard white bread or wholegrain bread products. By using specific

parts of the wheat grain kernels, breads with higher levels of dietary fibre and beneficial nutrients such as B-vitamins, minerals and anti-oxidants are being obtained. The innovative results of the HEALTHBREAD project are a range of bread products varying in appearance and taste, all rich in healthy cereal fibre, with a mild flavour. This is achieved through fractionating, applying the bio-processing fermentation, and selecting wheat types with light colour and mildness in taste and with significantly better availability of minerals for uptake in the body.

## **The end-users: The HEALTHBREAD brand product is first purchasable at traditional bakeries**

Without compromising on the taste associated with conventional white and whole-grain breads, the HealthBread project proposes new healthy bread products for local and regional markets.

The loyal traditional consumers of SME bakeries who engage in the HEALTHBREAD project will have the opportunity to purchase the new nutritionally enriched bread products as the first end-users. Consumer groups across four countries will taste and experience the difference of choosing a healthier bread option not yet available in Europe.

## **The inventors: Research organisations, technology institutions, industry, craftsmen, consumer teams, communication experts and international mentoring partners**

Driven by eight European SME bakeries from Austria, Germany, Italy and the Netherlands, the HEALTHBREAD project also



draws on the expertise of internationally acclaimed scientists, and industrial partners. 17 organisations joined in the two-year collaborative project linking science, innovation and craftsmanship. The project is coordinated by TNO (Netherlands Organisation for Applied Scientific Research). With the potential to impact on the economic growth of SMEs, the project will disseminate knowledge across the baking sector in Europe.

An innovative 'mentoring system' was established to link-up the knowledge-creation within local operating SME artisan bakeries, industry partners and international research institutions. Three HEALTHBREAD partners with experience in communication with international research, EU project regulations and bakeries acted as mentoring partners using their mother tongue. This management innovation may serve as a model for the successfully linking of locally operative small companies to innovative international research.

### **Development stage: Marketing preparation phase**

A comprehensive business plan for HEALTHBREAD's eight bakeries will allow the identification of a marketing vision and illustrate a strategy with short, medium and long-term objectives. These business plans are confidential documents exclusively dealing with how these SME bakeries will be able to develop a product design, produce a marketing strategy and employ a marketing plan to enhance sales. Objectives outlined in these business plans are SMART (Specific, Measurable, Achievable, Realistic and Time framed). After the first testing phases in traditional bakeries in four countries, the brand will be launched in Europe. Details of the various locations of the HEALTHBREAD bakeries can be found on the website <http://www.healthbread.eu/>.

### **Policy impact: Contributing to public health and promoting innovation by SMEs**

The grand challenge: Health, demographic change and wellbeing assessments in population studies consistently indicate that the consumption of cereal fibre and other valuable compounds contained in three slices of bread significantly contributes to the prevention of heart diseases, diabetes and colon cancer. For the many consumers who are not inclined to consume wholegrain bread, HEALTHBREAD has developed attractive bread products.

The project also contributed to the innovative power of SME bakeries throughout Europe. The project successfully developed innovative products by elaborating and applying scientific and technological results from a former EU-funded research project. It thus not only contributes to the EU 2020 goals of an innovative and a sustainable Europe, but also to the competitiveness of European food SMEs and the food industry.

### **Next steps: HEALTHBREAD manual, IPR management, 'Bakers Bundle', roll-out**

On completion of the HEALTHBREAD project, the dissemination of the HEALTHBREAD manual will provide bakeries across Europe with guidelines on how to select flours and fermentation processes in order to produce naturally enriched breads, as well as strategies to reach consumers. HEALTHBREAD partners predict that over the next four years, new, nutritionally enriched 'wholegrain' and 'white' bread products will be produced across Europe. The sale of such products will provide SME bakeries with a competitive edge within the bakery sector across national and European markets.

To fully exploit the knowledge generated by the project and launch the brand, a number of IPR management and business-development concepts are being considered. One such marketing strategy includes a 'Bakers Bundle' which can be obtained from national distributors and will be made available to SME bakers across Europe. The 'Bakers Bundle' will present a package which includes a licence to sell products under the brand, the delivery of a certain number of kilograms of ingredients and an opportunity to attend training and receive support on how to develop brand potential and enhance consumer interest. The launch of new nutritionally enriched products will take place on the completion of the project in September 2014.



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# A DEEP LOOK INSIDE OUR CORNFLAKES

The INSIDEFOOD project develops high-tech solutions for monitoring food microstructures

## **The project: Measuring food microstructures for the development of new food properties and products**

Cereals are, after milk and fruit, the product most consumed by Europeans – flakes are eaten in the morning, bread accompanies any meal and crackers act as snacks. The delivery of constant and stable starch qualities to these products depends on good processes in food manufacturing. Looking into the food's microstructures, many transport characteristics can be better understood, such as colours, crispness or crunchiness.

Food processing operations affect food microstructures: existing structures are destroyed and new ones are created. For instance: the sugar and gluten contents of manufactured pastry can be better controlled through technological measurements; the sponginess of bakery and pastry products can be better steered through knowledge of the microstructures. Not only should processed food be better monitored for optimised qualities, the microstructures of fresh and dried fruit should also be the subject of closer inspection in order to identify foreign content, to detect bitter pit, core browning or water cores. To make significant steps towards improved food monitoring, the project INSIDEFOOD focused on using different technologies to measure the microstructures of the products: 3D imaging, measurement of water and soluble status, texture properties and optical properties. The project was completed in May 2013 and is now looking to apply the spin-offs in several ways.

## **The product: 3D-imaging, sensor, and x-ray instruments for texture measurement, optimised processes, applications**

The aim of INSIDEFOOD is the design of dedicated applications for fruit and cereals: sugar, and gluten-free products were given particular attention, as these two restrictions have a crucial influence on the texture of cereal products. Crispy dried fruits as healthy snacks containing vitamins, minerals and fibre were tested as well as new extracted cereals which were tested for enhanced crunchiness.

Foams, gels, cereals and fruit were the research models in the INSIDEFOOD project. The researchers inspected them with scanners and optical techniques which were already available in bio-medicine. Along with this, INSIDEFOOD developed new

and accurate technologies that signal changes in the internal food composition and microstructures, especially of micro-porous foods containing large amounts of air. The quantum leap was the 3D visualisation of internal food structures without destroying them.

Various 3D imaging methods were optimised. Almost all investigated methods operated in a contactless mode, which is a prerequisite for future at-line or in-line measurements. Special emphasis was put on speed, sample size, field of view, penetration depth, contrast and sensitivity to micro-structural differences. Spectroscopic techniques (NMR relaxometry), and slow Magic Angle Spinning (MAS) were optimised to extract information about the water and solute status of microstructured foods. Other notable successes have been the acquisition of the first on-line NMR relaxation spectra of apples using a prototype on-line NMR sensor and the discovery of useful correlations between the MAS spectra and the effects of storage.

Appropriate methods and parameters were selected to determine mechanical and acoustic properties of the model foods. Microstructure was shown to have a larger effect on the texture of candy model gels than the chemical composition. In addition, quantitative data was collected on the texture properties of the food products using force-deformation measurements in parallel to acoustic measurements. The obtained results can be applied to monitor and control the texture of food products in industrial conditions.

Optical systems based on time, and space-resolved reflectance spectroscopy (TRS and SRS) were optimised for the project's model systems, and upgraded systems were successfully made operational in the lab. Physical models have been delivered to describe water transport and light propagation in complex microstructured fruits. For the first time, water transport in





fruits was quantified at the micro-scale level explaining the relative importance of the different microstructural features for water transport.

Non-contact sensor technologies have been optimised for real life on-line and at-line food applications.

### **New technologies: Industrial products, prototype sensors, modeling software**

Industrial products:

- Desktop Nano- and Micro-CT for micro-structure assessment of fruit and bakery products
- 3D-visualisation and analysis software
- New technological applications of HR-MAS and micro-MRI spectrometers

Prototype sensors:

- Fast and compact OCT sensor for contactless fruit-surface-quality assessment, dynamic assessment of rehydration processes, measurement of coating effectiveness
- Low-cost on-line MRI sensor for internal quality inspection of fruit
- TRS and SRS spectroscopy sensors for at-line screening of fruit quality
- Acoustic emissions sensor for at-line measurement of cracker texture

R&D modelling software:

- Moisture transport in microstructured foods
- Light penetration in foods
- Multivariate statistics

### **The end-users: Food manufacturers, SMEs and labs, the scanner and sensor industry, food consumers**

Food manufacturing and crafts will benefit from research and development results in order to optimise the quality of processed food, to control health properties and to optimise processes in waste and energy reduction and to increase labour productivity.

SMEs and labs will benefit from new analysis, and control-technologies ICT industries and device-producers will adapt existing scanning and sensing technologies towards 3D visualisation and 3D printing of food.

Consumers will benefit from the enhanced food quality.

### **The inventors: Academics, research institutions, technology producers, ICT industry, food industry**

12 partners across Europe collaborated in the project.

Research institutes: University of Leuven, BE; RECENDT, AU; Institute of Food Research, UK; Politecnico di Milano, IT; Universidad Politecnica de Madrid, ES; Warsaw University of Life Sciences, PL.

ICT and sensor companies: VSG, FR; Bruker micro-CT, BE; Bruker BioSpin, DE.

Food sector: Flanders Centre of Postharvest technology, BE; Chaber, PL, Nestlé, CH.

INSIDEFOOD addressed several sensor technologies and 3D-visualisation techniques for the optimisation of food processing focusing on the production of new bakery products,

the process-control of downstream processing of breakfast cereals, and the optimisation and process-control of osmo-air dehydration of fruit.

A list of the concrete achievements and inventions of each consortium member can be received from the technology transfer manager of INSIDEFOOD, Pieter Verboven at KU Leuven (Pieter.Verboven@biw.kuleuven.be).

### **Development stage: Proof of concepts, demonstrators, market readiness**

Several technologies are already on the market now through one of the partners in the consortium (Bruker BioSpin, Bruker micro-CT, VSG), while others are in a more advanced level of technological readiness. In a follow-up phase for these techniques we seek to set up collaborations with interested end-users or technology developers to bring the technology closer to the food industry. A detailed status of the different technologies can be found in the Assessment Report of the technologies that can be downloaded from [www.insidefood.eu](http://www.insidefood.eu).

### **Policy impact: Competitiveness of the European bio-economy, ICT and sensor industries**

As INSIDEFOOD's focus is predominantly on business, the contribution is to enhance European competitiveness and innovations in the food industry and to create new jobs and growth in high-added-value productions and in high-tech industries. The RTD efforts of the project are in line with the Europe 2020 strategy for smart, sustainable and inclusive growth.

### **Next steps: More practical applications**

Current initiatives include continued R&D efforts through large scale projects such as PICKNPACK and TOMFOOD (e.g., [www.picknpack.eu](http://www.picknpack.eu), [www.tomfood.be](http://www.tomfood.be)) and multiple bilateral collaborations between R&D partners and interested end-users. Food-industry or sensor-technology developers are invited to contact us to discuss more dedicated tests and potential collaborations towards practical applications.

The prime target sector for the INSIDEFOOD project is the entire food industry. New technologies, products and processes made possible by the sensors developed by INSIDEFOOD will contribute to the increased innovation performance of food companies and enhanced labour productivity.



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# MOLECULAR CUISINE FOR THE 'BON APPÉTIT' OF THE ELDERLY

How the PERFORMANCE project makes  
mashed food look good

## The project: A masterplan for personalised 3D food-printing

A dinner with lamb, beans and chips for a 90 year-old lady? Even elderly people with mastication and swallowing problems will soon enjoy a traditional menu when the result of a new food-processing project enters the market. The EU-funded PERFORMANCE project works on the concept of processing pureed food, which provides appropriate texture, visually appealing shapes and high-nutritional value. Through high-tech processing, the purees look like pieces of real food: red and juicy tomato slices appear naturally, as they are made of real tomatoes prepared with a specific texturing system. Roasted chicken breast is presented on the plate, but in fact it is jellylike, easy to cut with a spoon, providing a smooth texture without any taste differences to the original material. The chicken breast is refined with a nice brown sauce – for the *bon appétit* of the elderly in nursing homes and pensioners in day care at home.

Because these meals normally require immense inputs of time, the PERFORMANCE project aims to develop a technology that allows the manufacturing of convenient, personalised food with a 3D printer. This means personalised smoothfood will be manufactured on an industrial scale and delivered to nursing facilities, allowing molecular cuisine meals to be served on a daily basis to a larger group of people. Renowned chefs have created a variety of recipes for jellified meals, cream desserts and fruit foams. Through the envisaged PERFORMANCE food-printing technology the chefs' recipes can go into personalised manufacturing.

## The product: A new food-processing technology for specific consumer groups

As part of the PERFORMANCE concept, the results of the project will comprise a demonstration unit of a 3D food-printer as well as new texturing systems, in order to shape the freshly cooked and pureed food, a new personalised packaging system, and a convenient food preparation solution. All will be complemented by a central software platform, registering key information such as the ordering and recording of the individual meals, the individual requirements and the actual meal consumption.

According to the specific order, personalised meals can be produced, packed and finally delivered frozen. Each individual

meal is identified by a unique identification code, before it is heated and served to the corresponding consumer. All ordered meals will differ in size, texture and nutrient supplementation.

## The end-users: Frail and elderly people, nursing homes and industry

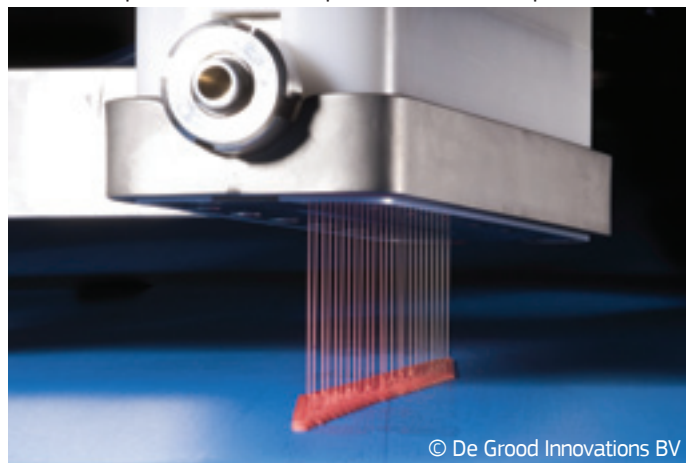
Stroke or dementia can lead to chewing and swallowing difficulties also known as dysphasia, which can have serious consequences such as malnutrition, nutrient deficiencies or dehydration. The most common diets for these people are mash-type food. Malnutrition in elderly people who require a mash-type diet is therefore of particular concern and shall be addressed within the scope of the project.

PERFORMANCE personalised food is mainly targeting frail and elderly people in nursing homes and in ambient assisted-living facilities as well as the elderly living at home. Nevertheless, the concept can be adapted for any other person with mastication and swallowing problems, like young people suffering from dysphasia after an accident or stroke.

As well as the consumers, the food industry will benefit from the research-and-development results. The project will provide an integrated approach fully applicable to SMEs.

## The inventors: SMEs, research institutes, care institutions

PERFORMANCE is based on the smoothfood concept commercialised by the project coordinator, Biozoon. This concept is based on handmade meals using fresh ingredients which are pureed. The concept aims at the simplification and



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industrialisation of the smoothfood meals. 14 beneficiaries from 5 European countries are involved in the development of the technologies, products and services. PERFORMANCE is an industry-driven research project with the majority of partners (8 out of 14) being Small or Medium sized Enterprises (SMEs) illustrating high innovation potential. The consortium is completed by research institutes in the field of food technology, processing technology, packaging and logistics as well as two nursing homes. This consortium covers all the scientific and technological knowledge needed for the realisation of the integrated approach, covering the whole supply chain.

### **Development stage: Proof of concept, towards demonstration**

The PERFORMANCE concept validation will deal with a proof of concept for the production of personalised foods. The concept integrates newly developed texturising systems for food printing, a technology platform for the realisation of food production and a packaging concept in a holistic approach for a personalised food chain. A software solution will contribute to personalised recording and tracking of dietary requirements for individual clients and will thus allow optimised chain management.

### **Policy impact: Increase the quality of life in the sunset years, improving health and care status**

The ageing society is not a problem which is limited to any borders but rather a global challenge. Due to the size of this challenge and the special needs of this specific group, a lot of societal implications are involved, such as the increase of medical and care costs, needs for special products for the elderly and a decrease in the number of people paying into the welfare system. This requires a European approach for the development of new concepts. The novel approach through texturising and 3D food printing, will contribute towards a better quality of life for the elderly population.

### **Next steps: Demonstration and marketing phase, consumer acceptance study**

An important task of the project is to bridge the gap between the research results (development of a new production process using rapid manufacturing) and the consumer market (industry, nursing homes, and consumer acceptance).

A symposium with a high industrial participation will be organised to communicate the path and the achieved results.

Several demonstration workshops will be carried out to ensure efficient technology and knowledge transfer into the European food industry as well as nursing homes or care home operators to facilitate the later uptake.

Development of detailed exploitation and marketing strategies is the key interest for the participating SME beneficiaries and will ensure that a return on investment will be achieved as quickly as possible.

A final consumer acceptance study will be organised to test the sensory acceptance of the meals in order to illustrate one of the most important success factors besides affordability of these new food products.

Due to the fact that nutrition is strongly correlated with aspects of health, physiological and psychosocial status, especially for elderly people, PERFORMANCE can be seen as a great step forward in social innovation.



#### **PERFORMANCE**

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# BEST PLANT YIELDS: WATER AND ENERGY USE OPTIMISED THROUGH PRECISE DECISION TAKING

With FIGARO, farmers and growers will save resources and money

## The FIGARO project: Precision irrigation systems at work

The FIGARO project is developing a decision-support system to allow farmers and growers to benefit from cutting-edge technology. The aim of the project is to offer reliable, cost-effective, user-friendly and flexible tools to optimise the use of water on farms, through the application of precise irrigation criteria, while achieving the same or even increased yield.

The FIGARO system will collect and integrate environmental and crop data from sensors, prediction models and remote imaging, feed this data into state-of-the-art crop models and provide accurate, precise and reliable recommendations for how much and when farmers should irrigate their crops, using a simple user interface. The result is a user-friendly yet sophisticated DSS (decision support system) that will provide daily irrigation recommendations to each individual farmer and grower, based on the particular crop, conditions and parameters monitored in the field.

These suggestions are presented through web or smartphone interface and can be automatically downloaded into the irrigation controller for automatic execution.



## The product: A multi-source integrated management system

The envisioned project result is an operational decision-support platform able to integrate and manage information coming from many sources, such as weather forecasts, soil and plant sensors, meteorological data and satellite images. The platform provides an optimised estimation of irrigation requirements which is validated and tested by farmers and researchers at eleven sites. This application is composed of software with both a PC-web and

a smartphone interface with a server which will run selected crop models, specific hydraulic and weather forecast models and is linked to a large database. Each day the farmer/grower will get an updated recommended irrigation plan for the next seven days based on the mentioned models, sensors and database. According to these recommendations, it will be possible to optimise the exact quantity of water and fertilisers, increasing water productivity without causing any harm to the crops and, when possible, improving the yield.

## The end users: Farmers, growers, agricultural counselors, precise farming suppliers

Agricultural counselors will most benefit from the FIGARO developments as they will spread news of the available technologies as well as implementing the ready-to-use platform for the farmers.

Agricultural and horticultural producers will reap the benefits of using energy, and cost-saving irrigation technologies.

Software companies can adapt the project findings towards integrated e-applications for end users.

## The inventors: Industries, academics, associations, public bodies

The FIGARO consortium is industry driven, as it is coordinated by Netafim, a large multinational company specialising in irrigation technology, and includes an additional six SMEs, most bringing expertise in precise irrigation-related technologies.

The consortium is augmented by eight academic institutions including seven prestigious universities and a research centre. They will collectively contribute with their vast experience and expertise in order to provide a real and tangible product by the end of the project.

The academic teams represent leading academic institutions in this field and include the Danish University of Aarhus, the Polytechnic University of Valencia, the Technical University of Lisbon, the University of Bologna, the Technion-Israel Institute of Technology, the Democritus University of Thrace, the University of Twente and the Consorzio di Bonifica per il Canale Emiliano Romagnolo (CER) research centre. These universities and research institutes will contribute to the various models and apply academic standards, the proof of concept and they will also analyse the performances of the project.

The industry is represented by Netafim LTD, a leading irrigation



company from Israel as well as small/medium enterprises including Hydrologic Research from the Netherlands, C-Tech Innovation & Eden from UK, Hidromod from Portugal and AgroSens from Denmark. Together, these companies will translate the academic contributions into commercial solutions and will run the field tests with both large industrial and small farmers. Agora Partners provides the necessary project management expertise.

Last but not least, the project includes some grower representatives and public bodies: the FAO of the UN, CER from Italy and Regional Union of Municipalities of Eastern Macedonia-Thrace in Greece.

### **Development stage: Field testing and platform prototyping**

The project includes 11 field tests throughout different climate regions in Europe testing the main water-intensive crops (maize, potato, orange, cotton and grape). The prototype of the system is already installed in the test fields, together with different sensors, such as weather stations and soil-moisture sensors. For the crop model we use the AquaCrop model from the FAO and the well-known Daisy model. For the hydraulic model, we use EPANet and for the weather forecast we use the Hydrologic research model.

Over the next two years this platform prototype will be improved and open to additional models and sensors, which will be tested in field immediately. The last year of the project will be devoted to the dissemination and exploitation of the results as well as to the training of potential users.

### **Policy impact: Environmental and climate-protection goals**

As this project aims to develop practical tools to save water, FIGARO could facilitate many policy opportunities for policy and decision makers. For instance, policy measures aimed at increasing agricultural water productivity while fulfilling EU regulations, such as the water framework directive (WFD 2000/60 EC) could include the FIGARO platform as an essential.

### **Next steps: Demo sites, field days for farmers and exploitation**

The project includes the preparation of a dissemination-and-exploitation plan. For the duration of the entire project, with an emphasis in the last year of the project, we intend to meet with policy makers, farmers and growers' representatives at the regional, national and European level, agronomic service providers and other

agriculture and water stakeholders, to expose them to the potential benefits of using the FIGARO Decision Support System (DSS).

Out of the eleven field tests, seven will be chosen for demo sites where open-field days for farmers and growers as well as for policy, and decision-makers will be organised in order to present the system capabilities. The open platform of the system will increase the exploitation as each grower can use the best models and sensors to meet their individual needs.

The FIGARO DSS-system is a modular and flexible platform and thus always open to the addition of more models, sensors and other sources of data in order to further enrich the system capability and output quality.

The need to save water is not only a European issue, but a global one and the consortium intends to distribute the system across Europe and beyond to other continents.



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# SENSING AND DOSING FOR BETTER CROP YIELDS

The OPTIFERT project develops water and fertilisation technology

## The project: Understanding the needs of crops and adapting irrigation and fertilizer doses accordingly

There is a growing need for an increase in productivity in modern agriculture and crops production. Increased productivity is the only solution to meeting future demand and restraining rising prices. Of course, this must be achieved in a sustainable way. Rising fuel and fertiliser prices, as well as their anticipated scarcity, add to the challenge. Climate change and the consequences such as weather unpredictability complete the picture. We need to be able to better monitor and understand the needs of crops in real time. We need to be able to achieve the targeted yield and at the same time use our resources efficiently and eliminate the risk of pollution to soil and ground water. The technology developed in OPTIFERT aims to deliver tailor-made irrigation and dosage of fertilisers simultaneously using high-tech solutions through 'fertigation'. This will help farmers and agricultural advisors to achieve better yields, environmental protection and resource preservation.

## The product: Soil sensors, dosage units and software

Three modules have been developed in OPTIFERT:

- The OPTIFERT dosing unit has been designed to deliver any fertiliser combination needed for open-field crops like corn, sugar beet, rapeseed, potatoes or wheat, amongst others. The unit can be coupled with any irrigation system, adapting the fertiliser concentration according to the needs of the specific crops.

In the OPTIFERT dosing unit tanks, water-soluble fertilisers can be easily discharged using big bags. The two tanks allow the creation of any combination of fertilisers with no risk of precipitation. The OPTIFERT dosing unit has been designed to allow high flexibility. It can handle and deliver the required fertiliser concentrate no matter what the irrigation water flow might be. This fully automatic system will adapt the injection ratio according to the existing irrigation flow or speed, ensuring that the right fertiliser dose is delivered even if the irrigation rate is changed during the application. Once the fertiliser has been dispatched in the tanks and the system is switched on by the user, the mixing and dosing phases will follow automatically, with no other user input needed.

- OPTIFERT Soil Sensor

In modern agriculture the amount of the macronutrients NO<sub>3</sub>, NH<sub>4</sub>, K and PO<sub>4</sub> in soil is commonly adjusted by the application of fertilisers. The fertiliser dose has to be carefully adapted to the plant demands, since both under-supply and over-supply lead to reduced yield. In addition, excessive use seriously harms the environment if fertilisers are not taken up by crops, but get washed into ground water. In order to apply the appropriate amount of fertilisers, precise knowledge of nutrient concentrations in the soil is required.

At the moment there is no mobile and user-friendly system on the market, which allows the concentrations of all these soil nutrients to be measured. Therefore, a fast and simple method for the routine surveillance of these nutrients is not yet available. Laboratory analysis or the complex application of several measurement procedures have to be applied. As a consequence, the applied fertiliser dose is often based on estimations, with adverse effects on environment and profit.

We have developed a soil-nutrient sensor system for the combined measurement of NO<sub>3</sub>, NH<sub>4</sub>, K and PO<sub>4</sub> on site. For the measurement, a soil sample is suspended in a universal extraction liquid. After filtration, the amount of dissolved nutrients is measured in this liquid. In this way, only a single extraction procedure followed by a single measurement is required, minimising the work for the generation of nutrient concentration maps and depth profiles.



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The analysis of all macronutrients NO<sub>3</sub>, NH<sub>4</sub>, K and PO<sub>4</sub> is possible in a single run, within 120 seconds. Additionally, the sensor can be expanded to include a pollutant analysis by measuring further sample compounds like NO<sub>2</sub> or Cl.

- **OPTIFERT Software**

The required quantity of nutrients that crops need vary during the growth season, and depend on soil characteristics and weather conditions. The OPTIFERT software will align the relevant crop-growth model with on-site weather data and the soil data collected by the OPTIFERT soil sensor. This way, the software will provide a fertigation recipe, covering the nutrient demands of the crop for the following growth period. This allows precise use of fertilisers, based on on-site measurements. The fertigation recipe can be delivered by the OPTIFERT Dosing Unit.

### **The end-users: Farmers, cooperatives, fertilizer industries, agro-machinery producers**

The future clients of the OPTIFERT system will span the entire primary production chain in crop production and horticulture, including agricultural-machinery producers, fertiliser manufacturers, agrochemical producers, irrigation-technology producers, farmers, and all cooperatives and organisations involved in agriculture and horticulture.

### **The inventors: Researchers, technology transfer institutes, industries**

A multidisciplinary team of agronomists, biologists, physicists, software creators, electronic and chemical engineers, coordinated by ttz Bremerhaven, has taken part in developing the system. The applied research-and-development provider has been largely involved in different projects and approaches related to fertigation, collaborating with OPTIFERT partners such as Hydroair and UWM. The need for further optimisation and automatization in open fields became clear, and the idea of OPTIFERT was conceived. After developing the proposal, ttz has been in charge of the general coordination of the project and the design, construction and testing of the dosing unit. As for the sensor, the University of Bremen and the Technical University of Vienna have led the development, with support from UWM in the sample-extraction methods and SME Pessl in requirement specifications. The software module has been developed by TUW, with support in the agronomic aspects from UWM. All participating SMEs have guided the development and validation phases, and are now involved in the marketing.

### **Development stage: Prototypes**

All three OPTIFERT modules (soil-nutrient sensor, dosage unit, software) have been developed and validated to a prototype stage.

### **Policy impact: Avoidance of soil degradation and over-fertilization**

Many projects develop new policies as a main goal, or as a by-product of their research and developments. There is a general consensus that European farmland is over fertilised. The JRC reference report 2012, shows that many soil-degradation processes are accelerating in many parts of Europe, often exacerbated by inappropriate human activities and widely varying approaches to tackling the degradation processes.

OPTIFERT supports the EC legislation 'Pollution caused by nitrates from agricultural sources' 91/676/EEC, and will be key to tackling the problems in Nitrate Vulnerable Zones (NVZs), where the

application of the Codes of Good Agricultural Practice, limitation of fertiliser application (mineral and organic) is mandatory. In these regions, taking into account crop needs, all nitrogen inputs and soil nitrogen supply is essential.

### **Next steps: Final product validation, marketing, new projects**

After validating the system in a 25-hectare corn field in Brandenburg, Germany during the season 2013, the prototypes now need to enter a final product-development and validation phase for them to be sold. Our research project ended in November 2013, when a market survey was conducted through our website. The market response has been very positive, and the OPTIFERT sensor was awarded a silver medal at the Agritechnica 2013 Innovation awards. The participating SMEs in the consortium are willing to continue the product development. A wider validation campaign across Europe will be needed in order to gather more statistical data, fine tune the details and offer guarantees to the customers.

The OPTIFERT consortium is involved in Horizon 2020 and national proposals to continue the development and make the technology marketable.



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# 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



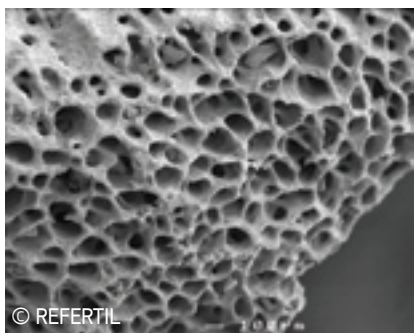
3R technology include recyclers, animal-waste rendering industries, the agro-chemical industry as well as the fertiliser industry.

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.



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# SMART USE OF WASTE WATER HELPS TO SAVE THE PLANET

The TREAT&USE project offers technologies for rural and urban areas

## **The project: Bringing forward innovative and safe waste water treatment systems for irrigation in agriculture and horticulture**

TREAT&USE technology will enable the smart, safe and sustainable recycling of waste water. Given the growing water scarcity on our planet, the technology can be tailored for agricultural irrigation as well as to horticulture and urban or peri-urban gardening. The compact system design makes it very appropriate for small agglomerations in rural areas. But the TREAT&USE system can be also used in areas where a centralised treatment of the waste water is implemented. There, the new technology can add an up-graded treatment to already pre-treated, local waste water. This will allow compliance with the strict legal standards required for water reuse in agriculture. A main goal of the project is to increase the number of southern European farmers who have access to a reliable amount of safe irrigation water and nutrients for their plants.

## **The product: An automated and safe waste water irrigation system with fertilizing properties**

TREAT&USE aims for the construction of a pre-commercial prototype which combines water treatment with membranes and an adapted irrigation system so that the overall process is completely automated, keeping operation and maintenance requirements to a minimum. The product which will come out of the project comprises four individual modules: the water-treatment module; the mixing station; the fertigation module; and the control-and-monitoring module.

A membrane bioreactor (MBR) has been designed for the water-treatment module in such a way that plant nutrients contained in waste water (mainly nitrogen and phosphorus) are recovered after the treatment, while pathogens are killed.

The mixing station will mix the appropriate proportion of fresh water and the treated waste water coming from the MBR and feed the fertigation module, which is a combination of fertilisation and irrigation.

To achieve this, the level of nutrient content in the soil is detected by sensors and this information is sent by remote devices to the control-and-monitoring unit, which will translate the signals received into specific orders to the valves of the mixing unit.

## **The end-users: Farmers, associations, cities, governments and their water managers**

TREAT&USE will cater for farmers and farmers associations. Two target groups in agriculture are envisaged: farmers who already use waste water and wish to see better product quality ; and farmers who suffer from water shortages and are interested in alternative water sources.

Other end-user groups are horticulturists and farmers or gardeners in urban and peri-urban areas. Aside from the economic reasons to save water and energy, they could be interested in caring for the overall water resources. The waste water nutrients will be reused within the offered fertigation system to nourish new plants.

## **The inventors: Academics, technology transfer experts and SMEs**

TREAT&USE is built on the outcomes of two successful, completed European research projects on waste water treatment, reuse technologies and fertigation and monitoring systems: PURATREAT and WACOSYS. In PURAREAT several promising low-energy-consuming MBR systems (laboratory prototypes) have been developed, adapted and tested with the aim of treating communal waste water in a low cost way for agricultural reuse options. Likewise, WACOSYS has developed, tested and optimised a monitoring-and-control system for waste water irrigation of agricultural production schemes (biomass production).



TREAT&USE has combined the results of both PURATREAT and WACOSYS projects and upgraded the technology already developed to a system which has the capacity to irrigate food crops. The expected result is a prototype of a suitable, safe and low-cost MBR waste water treatment unit.

The overall coordinator of TREAT&USE is the Spanish company BIOAZUL, also developer of the MBR system. The project also includes the participation of six other European organisations: ttz-Bremerhaven (scientific coordinator), HYDRO-AIR (developer of the irrigation system), ISITEC (developer of the control unit), PESSL (developer of the monitoring system), Soil Moisture Sense (developer of irrigation schemes), and GUADECOL (end user).

### **Development stage: Scaling-up, prototyping and validation**

The project's goal is to demonstrate the technical and economic viability of the developed system. Therefore a prototype will be the main output of the TREAT&USE project. This would enable the project to reach the last stage in the innovation-and-development cycle before entering industrial production and markets.

Testing and validation within the project are the main activities that will enable SMEs' uptake of the technology for production and marketing. Most of the efforts are focused on low operation and maintenance costs. Energy consumption is being optimised during the last phase of the project and is achieving important results.

A toolbox of technological solutions and released guidelines for decision makers will be provided to take informed decisions on effective environmental strategies.

### **Policy impact: Influence on legislation to reduce freshwater consumption and to reuse treated water with new technologies**

In Europe, 46% of the population live in places that are water-stressed. Most of these regions have high abstraction for irrigated agriculture. It is likely that predicted climate change will exacerbate this situation in the future. Although the reuse of waste water is encouraged at high levels, many EU Member States still lack appropriate guidelines and national legislations addressing the issue of waste water reuse. The dissemination of the project through its website, social networks, press releases and presentations in conferences, aims to influence future policies or legislations. TREAT&USE aims to minimise fertiliser and water consumption. The share of farmers using treated wastewater as a safe source of irrigation could be increased by 15% in Spain and 10% throughout southern Europe. Overall, the technology could lead to a 35% substitution for freshwater abstraction for irrigation, and a 15% reduction in fertiliser use in Europe. In other terms: 30 000 mega cubic meters of water and 4,5 m tons of fertilisers could be saved.

### **Next steps: Networking, market analysis and marketing strategies**

One of the strategies of the TREAT&USE partners is to act as an environmental lobby. In this context, the strong participation of different action groups or networks is anticipated. Several TREAT&USE partners are already involved in other initiatives such as SuWaNu project with this purpose. Due to the different benefits of water re-using technologies (environment,

economic, etc.) it is important to involve public-private partnerships in this network in order to promote the waste water reuse and share the costs.

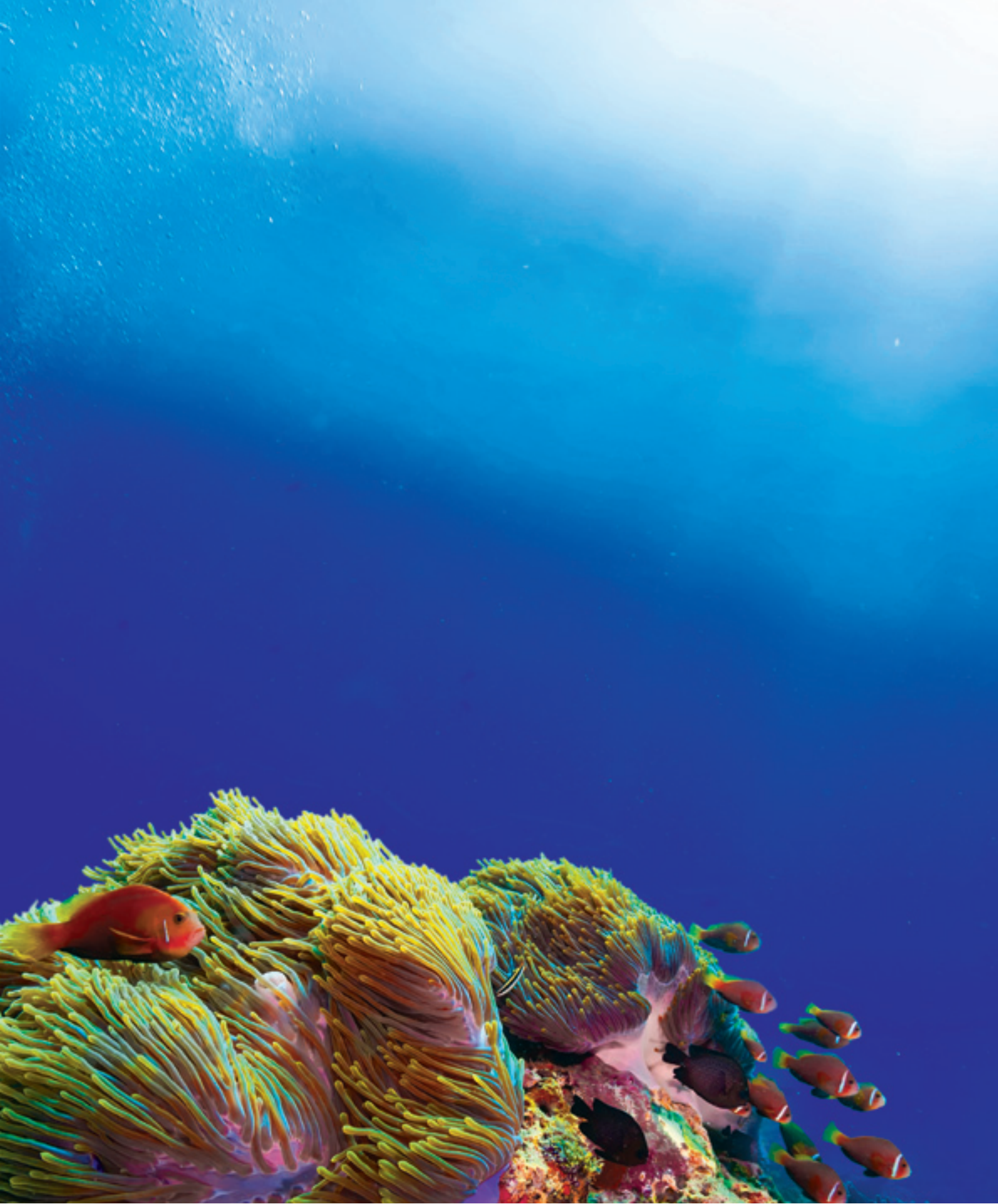
An initial market analysis will be performed in the frame of the project. Afterwards, the consortium will hire the services of a professional firm to carry out an in-depth market analysis and define a more specific marketing strategy. The market niche for TREAT&USE will be water-scarce regions with intensive agricultural production such as Southern Europe (Spain, Greece, Italy) or North Africa where governments are willing to promote waste water treatment or where water scarcity is so acute that they are obliged to cut supply.

The current model of subsidies to freshwater irrigation does not only prevent farmers to produce more sustainably, it also externalises the environmental costs to future generations: they will suffer the consequences of groundwater salinity (already a problem in countries like Spain, Malta or Italy) and freshwater scarcity. Public authorities therefore are one of our future targets in the dissemination and exploitation strategy of the project.



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