

RE-LIVE WASTE- Improving innovation capacities of private and public actors for sustainable and profitable REcycling of LIVestock WASTE

## Reports for horizontal project

<b>Project title and acronym</b>	<b>RE-LIVE WASTE</b>
<b>Work Package</b>	WP-2
<b>Deliverable n. and title</b>	D281 Reports for horizontal project
<b>Responsible Partner</b>	NRD-UNISS
<b>Participating partners</b>	MoA, CUT, SERDA, FAFS, SERECO, LAORE, ALIA, FGN, LA UNIO.
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<b>Dissemination level</b>	Partners; JS

On May 19, 2019, project partners were requested to provide Legal Recommendations and Green Book inputs by the SYNGGI horizontal project.

The following is the table provided to SYNGGI and the draft copy of the “Interreg MED Green Growth Community – Circular Economy White Paper No. 3”.

## Data collection form



### MED Green Growth Community

In view of the elaboration of the first draft of the Green Growth Book, each modular project is asked to answer to the following questions regarding its capitalization process. The answers should be ideally provided by those who, within each MP consortium of partners, are responsible for capitalizing the results.

Questions	Answers	Comments
<p><b>Which are the capitalization activities already carried out so far?</b></p> <p><b>Please also specify:</b></p> <ul style="list-style-type: none"> <li>• eventual critical issues and points of strength experienced during the process</li> <li>• eventual changes made with respect to your original capitalization plan and the reasons they were made</li> </ul>	<p>The project Interreg MED Re-Live Waste includes several activities included in WP4 (Transferring) for compiling the lessons learnt during the project and make them usable for further projects and stakeholders. The activities will begin, according to the project calendar, in October 2019.</p> <p>The cornerstone of this WP is the so-called “Knowledge transfer plan-KTP” which is used for planning, guiding implementation and following-up the activities. It will be implemented in 2 dimensions: horizontal (widening geographical transfer) and vertical (reaching the maximum types of stakeholders. Quadruple helix: research, business, public authorities, civil society).</p> <p>The activities foreseen in the KTP, as drafted in the proposal, are: workshops, site tours/open days, guidance documents for public actors and policy makers, and a final</p>	

	<p>conference. However, there will be 4 NEW activities identified by the consortium. The new activities and the reasons for incorporating them to the WP are:</p> <ol style="list-style-type: none"> <li>1. The main one is that the solution delivered by the project for animal waste (struvite production) is very complex from the technical point of view. Additionally, there are a good number of variables that would make the struvite technology economically viable. As we have realised that the stakeholders that can transfer this technology in other geographical areas (horizontal) or to stakeholders (vertical) are not necessarily specialists, the WP will now include two new deliverables: a “Comprehensive analysis of the technology used for Struvite production” and a “Comprehensive analysis of the business plan around Struvite production”. These will be layman documents that will summarize the key aspects of the technology and the economic feasibility, so partners and other non-specialist stakeholders can better do their job.</li> <li>2. The consortium considers that for making a real networking, common activities with other similar initiatives shall happen, and not just mere contact and exchange. The consortium will identify other stakeholders and projects with similar objectives and will propose a common action. The option that seems for feasible for now is producing a guide for highlighting different livestock waste management solutions in EU (coming from current and past Interreg, other EU programs, etc.) putting together different approaches and technologies. The drafting of this document would allow a closer cooperation between projects but also a better comprehension of the current solutions being explored. Another option is a common EU seminar but budget may be limiting in this case.</li> <li>3. Contacts with the European Commission (DG Env, DG Agri) will be made for organising a meeting in Brussels. After the partners’ experience, such meetings are very useful for understanding ongoing challenges in regulations (in this case a key aspect as struvite has just recently been approved as a fertilizer), knowing similar initiatives, contributing to EC specific technical documents etc.</li> </ol>	critical issues
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	<p>4. Finally, dedicated short clips (2 minutes purposes, so we make sure that all the actions of the project can be explained in a short and friendly way.</p>	I for transfer
<p><b>Which are the capitalization activities foreseen for the future?</b></p> <p><b>Please also specify:</b></p> <ul style="list-style-type: none"> <li>• eventual concerns about their outcomes;</li> <li>• eventual activities of the Green Growth community which you think could be of support for your capitalization process</li> </ul>	<p>As the above-mentioned activities (both foreseen in the proposal and new) are in a preparation phase, all of them are “future actions”.</p> <p>The main limitation for reaching the described outcomes is finding a minimum number of stakeholders for an effective networking and sharing our approach. Partners will suggest stakeholders for this WP but even though the number of them will be reduced. Most of the efforts will be devoted to identifying such stakeholders. In that sense, the Green Growth Community could contribute to the capitalization process by organising (or co-organising with other EU programs such as LIFE) dedicated events, platform meetings, etc. around specific topics. In our case, an EU-level event focusing on “closing nutrient loops in agriculture” would be very helpful.</p>	

Draft copy of the information provided to the Horizontal Programme for the publication of the “Interreg MED Green Growth Community – Circular Economy White Paper No. 3”

# ZERO WASTE: PROBLEMS BECOME OPPORTUNITIES

## *Waste prevention and management*

### About the Circular Economy White Papers

This White Paper is part of a series of thematic Circular Economy White Papers presenting the contributions of the Interreg MED Green Growth community to the transition towards a circular economy, in the areas of 1) Resource Efficiency, 2) Green and Smart Public Services, 3) Waste Prevention and Management and 4) Competitiveness and Innovation.

***A circular economy is ‘where the value of products, materials and resources is maintained in the economy for as long as possible, and the generation of waste minimised’.***

*European Commission 2015<sup>1</sup>*

<sup>1</sup> European Commission (2015). Closing the loop - An EU action plan for the Circular Economy.

The thematic White Papers are complemented with a transversal White Paper and accompanied by a set of Policy Recommendations and Legal Recommendations in the same thematic areas. The elaboration of the White Papers was led and developed by the SYNGGI project based on contributions from modular projects of the Interreg MED Green Growth Community<sup>2</sup>, through dedicated Thematic Working Groups on the four thematic areas.

## Waste Prevention and Management and the Circular Economy

The transition to the circular economy is a shift from the linear take-make-waste economic model to a model where the economic value of the resources is fully utilised and the burden on global natural resources is reduced. Ideally, all waste is prevented or recycled in a circular economy. As such products are designed in such a way that materials and components can be restored and re-introduced (looped) into the economy, from production and consumption to reusing, repairing, re-manufacturing, refurbishing and recycling. Figure 1 gives a holistic overview of the entire agro-food value chain demonstrating how the circular economy concepts can work within this sector. In transitioning to a circular economy, it is useful to distinguish between the technical and the biological cycle. The technical materials are non-renewable fossil and mineral-based materials such as metals or plastic, and therefore the aim is to loop these materials into the economy for as long as possible in order to utilise their full value potential<sup>3</sup>.

However, the biological cycle is one of importance to the agro-food industries and related supply chains. The biological cycle is renewable and characterised by the principle of cascading use (see Figure 1). This means, for example, that biomass from agriculture, the food industry or forestry is treated in bio-refineries and valorised as nutrients that can be turned into new bio-based products in a number of value-chains.

<sup>2</sup> <https://green-growth.interreg-med.eu>

<sup>3</sup> European Commission (2019) Sustainable Products in a Circular Economy - Towards an EU Product Policy Framework contributing to the Circular Economy

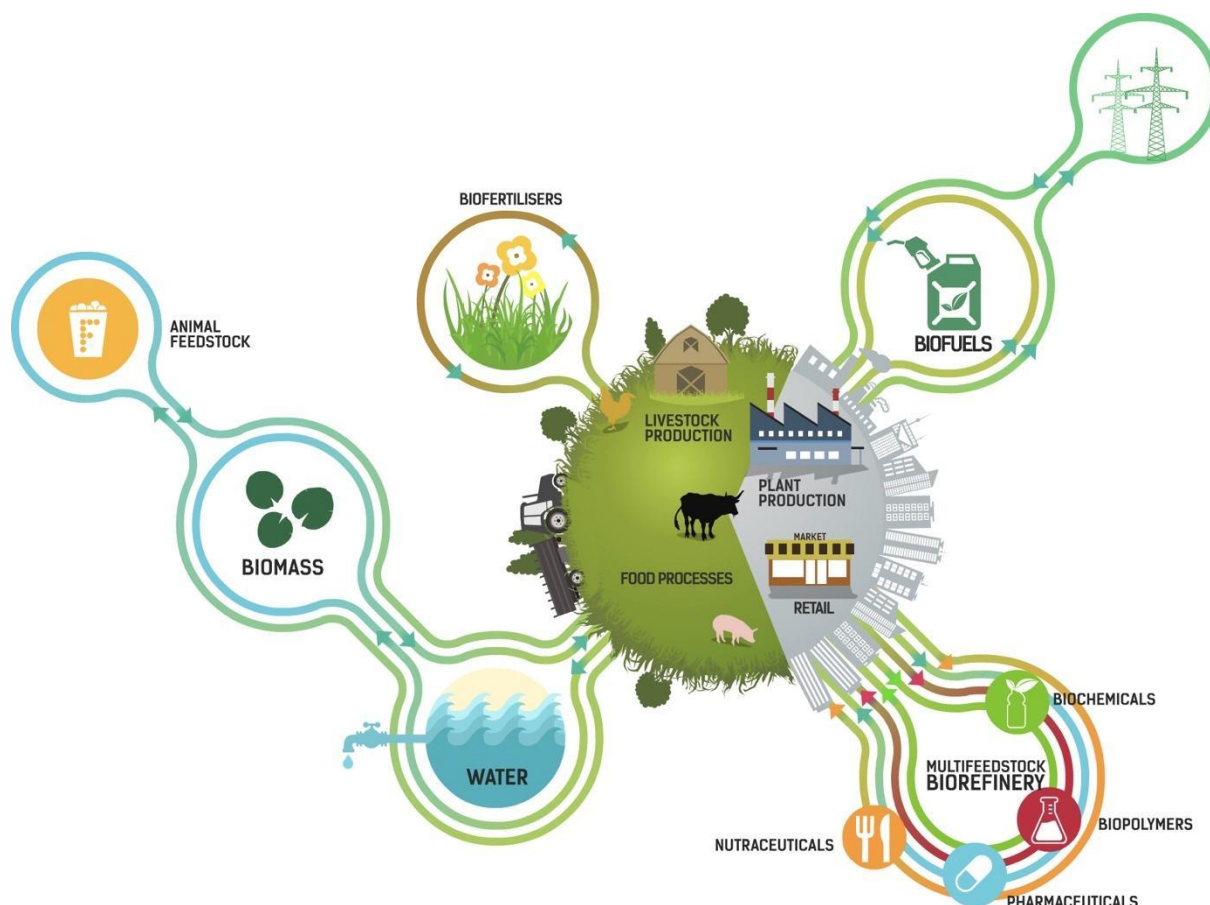


Figure 1: Circular Economy in the Agro-food Sector and Supply Chain. (AgroCycle Project 2019 <http://www.agrocycle.eu>)

A 2014 scoping study<sup>4</sup> analysed which materials have the biggest impact from a circular economy perspective and identified the following priority materials: agricultural products and bio-waste, wood and paper, plastics, metals and phosphorous. This led to the identification of priority products and sectors, which the study found to include amongst others: packaging and food. Managing the life cycle of these natural resources, from extraction through the design and manufacture of products, to what is considered as waste is essential to green growth and part of developing a resource-efficient, circular economy where there is no waste.

The transition towards a circular economy will be key for Europe and the Mediterranean's competitiveness but also to their long-term sustainability. Waste prevention and management will have to play a key role in this transition. It needs to become an integral part of a circular economy that contributes to waste prevention and the supply of high-quality secondary resources.

Although not part of the EU's Circular Economy Strategy, animal by-products (ABPs) (livestock waste) are no less important. The EU regulation on animal by-product waste<sup>5</sup>, the most stringent in the world,

<sup>4</sup> IVM et al (2014). Scoping study to identify potential circular economy actions, priority sectors, material flows and value chains.

<sup>5</sup> Regulation (EC) No 1774/2002

divides this waste into three categories according to the risk they pose. Recycling of livestock waste and other animal products, sometimes considered as waste materials, into animal feed, for example, can bring major benefits to the economics of livestock production and the environment in the EU.

The new Fertilising Products regulation<sup>6</sup>, undergoing the final steps of the legislative process, introduces harmonised rules for organic fertilisers manufactured from secondary raw materials such as agricultural by-products and recovered bio-waste. The new regulation includes the following points:

- substantially reduce significant market entry barriers for more sustainable and circular products;
- includes new limits on hazardous substances for all fertilisers, including from virgin raw materials, lowering the risk of material cycles containing dangerous levels of certain toxic elements;
- includes end-of-waste criteria, thereby contributing to the smooth functioning of the interface between chemicals, products and waste legislation and giving investors more legal certainty.

*For certain recovered wastes, such as struvite, ... within the meaning of Directive 2008/98/EC of the European Parliament and of the Council, a market demand for their use as fertilising products has been identified. Therefore, as of the moment of compliance with all the requirements of this Regulation, such products should cease to be regarded as waste within the meaning of Directive 2008/98/EC, and it should, therefore, be possible for fertilising products containing or consisting of such recovered waste materials to access the internal market<sup>7</sup>.*

However, in order to move forward and to increase waste prevention and recycling and reuse rates in the Mediterranean, the key challenge is to implement the circular economy policy principles into the existing waste management approaches, legislation and directives in the Member States and regions. This white paper sheds light on where those approaches, legislation and directives should focus.

## The Interreg MED Green Growth Community and its contribution to waste prevention and management for a circular economy

The objective of the Interreg MED Green Growth community is to promote sustainable development in the Mediterranean area, based on sound management of the natural resources taking into account innovation and with consideration of the effects on the labour market by promoting social inclusion and green jobs. Within this Interreg MED Green Growth community there are two modular projects that are driving circular solutions in one of the biggest industries in the Mediterranean (the agro-food industry) and are contributing to promoting waste prevention and management:

<sup>6</sup> <http://ec.europa.eu/transparency/regdoc/rep/1/2019/EN/COM-2019-190-F1-EN-MAIN-PART-1.PDF>

<sup>7</sup> Regulations (EC) No 1069/2009 and (EC) No 1107/2009 CE marked fertilising products amending Regulations (EC) No 1069/2009 and (EC) No 1107/2009 (COM(2016)0157 – C8-0123/2016 – 2016/0084(COD))  
[http://www.europarl.europa.eu/doceo/document/TA-8-2019-0306\\_EN.html](http://www.europarl.europa.eu/doceo/document/TA-8-2019-0306_EN.html)



- ❖ **RE-LIVE WASTE<sup>8</sup>** (*Improving innovation capacities of private and public actors for sustainable and profitable REcycling of LIVEstock WASTE*). The overall project objective is to improve the innovation capacities of public and private actors involved in the management of waste from intensive livestock farming (representing a major source of pollution, an environmental challenge for society and an economic problem for farmers), through stronger cooperation amongst the quadruple helix actors (academia, civil society, public authorities and the private sector). The project contributes to two key sectors in the Mediterranean regions (agriculture and livestock), by favouring innovative applications, which will make the livestock sector more productive, sustainable and competitive. The project tests pilot plants which transform livestock waste into organic high-value commercial fertilizers, contributing to smart and sustainable growth and to the creation of new business and market opportunities. The conversion of waste into high-value commercial fertilizers (an increasingly important issue for the quadruple helix stakeholders) is addressed by the project through a transnational network and by the design of a shared strategy to raise awareness. RE-LIVE WASTE contributes to reach the EU2020 strategy, addressing the targets related to employment, innovation, but also climate change and energy.



Figure 1: Struvite precipitation plant in Cyprus

- ❖ **REINWASTE:** (*REmanufacture the food supply chain by testing INnovative solutions for zero inorganic WASTE*). The project aims to bring a tangible contribution to the reduction of inorganic waste at source, favouring the adoption of greener innovative concepts in the agriculture and food industry, giving a special focus on SMEs. REINWASTE contributes to overcoming the persistent lack of knowledge on the available solutions and the diversity and fragmentation of inorganic waste prevention procedures, through a tailored mix of knowledge transfer services, based on a common open innovation model that will be tested by a Mediterranean network including regional bodies, Research and Innovation centres and clusters and agro-food business

<sup>8</sup> <https://www.youtube.com/watch?v=Qy7oiJUZKkc>

associations. Responding to consumers awareness, environmental regulations and market competition, REINWASTE aims to help agro-food enterprises to improve their production processes, reducing environmental impacts of inorganic waste by focusing on the most efficient and sustainable tenet of the waste hierarchy: 1. Waste prevention, 2. Material recovery, 3. Recycling and 4. Waste valorisation. In this regard REINWASTE aligns to the circular economy model in the waste sector.

To limit the production of inorganic waste, REINWASTE identifies and tests solutions to 3 Agro-food/agro-food chains.

- Horticulture in Andalusia – Spain
- Meat sector in Provence-Alpes-Côte d’Azur – France
- Dairy sector in Emilia-Romagna – Italy

## CHALLENGES AND OPPORTUNITIES ADDRESSED BY THE INTERREG MED GREEN GROWTH COMMUNITY PROJECTS

Moving from a linear economic model in a traditional sector such as Agro-food to a circular model is not automatic, there are significant challenges that the sector has to face in order to make sustainable changes. The increasing demand for food worldwide is affecting the natural resource consumption and leading to the production of vast quantities of by-products and agro-food-wastes, which need to be treated in an environmentally friendly manner. Specifically, within the Mediterranean region to appease the high food demand, cattle and pig livestock farming has intensified over the last 40 years, resulting in large quantities of waste that is required to be effectively managed. Intensive cattle and pig farming produces large quantities of organic waste and residues that represents an important economic problem for farmers and an environmental issue that needs to be minimized. The challenge remains to continue to increase the valorisation of many of these organic fractions from the agroindustry into bio-based secondary products or bio-energy, to reduce the impact of sewage disposal, or to recover nutrients to compete with mineral fertilized.

Specifically, in particular case studies:

- The total annual production of manure of in Bosnia and Herzegovina (BH) is 5,424,758 tons/y
- In the case study of the farm Butmir dairy farm in (BH) it produces 60 mc/day of manure. In this case the nitrogen produced from the site is 2.5 times more than the Nitrate Directive regulation.
- In the Sardinian case study (the Producers cooperative Arborea), the daily production of anaerobic digestate is 2,300 m<sup>3</sup> (1.000.000 m<sup>3</sup>/y). At present the Cooperative has an availability of 6000 Ha of agricultural surface devoted to receive this digestate. The whole surface is classified as vulnerable to nitrates with a maximum N yearly application of 170 Kg/Ha. The nitrogen applied on this surface is in excess of what the land can handle and thus falls outside of the nitrogen levels of the Nitrate directive.
- In Spain, 84million m<sup>3</sup> of slurry is produced in Spain, mainly spread on fields as fertilizer but the volume clearly exceeds the agricultural needs in production areas.

From 2017, there are regional regulations for limiting the way slurry can be applied. Some municipalities have further added more regulations (timing of applications, restricted areas...), thereby necessitating the need to treat the slurry.

- In Cyprus In 2013 total manure production was estimated around 1,591,862 t/y. Only 16% of manure is processed and the majority (84%) of it is left without treatment



*Figure 2: Bio-digestate in Arborea to be treated in the Struvite precipitation plant*

At the primary production level the challenge remains within the management of inorganic fractions, specifically in relation to plastics (films, nylon, greenhouse coverings, mulching plastic covers, agrochemical packaging and food packaging, silage film and plastic baling nets and wire, etc.), which are still difficult to recover and that are currently mainly disposed of by landfill and other environmentally sensitive routes (uncontrolled, abandoned or incinerated). For instance, the plastic used as protection material represents approximately 6 % of the total waste produced in intensive agriculture and the remaining 94% corresponds to organic residues. The estimation (done as part of the REINWASTE project) for 35,000 hectares dedicated to horticultural production in greenhouses in Andalusia shows that more than 93,170 tons of inorganic waste and a volume of 124,340 m<sup>3</sup> are produced every year. The maintenance of the cover structure and the plastic for disinfection are the productive functions with a higher importance regarding the weight (42% and 23%, respectively) and volume (40% and 19%, respectively) of waste produced. The materials used to carry out the above-mentioned tasks and, the main residues produced correspond to the metals from the structures of the greenhouses (40%) and the high-density plastic (HD) used in the covers.

Further along the Agro-food value chain, reducing inorganic waste has a number of challenges specifically with relation to improving inorganic material recovery along the food chain (at farm, in industry, at consumers levels).



The Environmental Implementation Review (2019)<sup>9</sup> shows that the waste streams and quantities produced in Italy in 2016, the total production of special waste in Italy stands at around 135.1 million tonnes in 2016, divided into approximately 125.5 million tonnes of non-hazardous waste and 9.6 million tons of hazardous waste. Approximately 331 thousand tons are referred to the agricultural sector. The impact of the agricultural sector, that includes agriculture, forestry, hunting and fishing, is 0.2% of the total waste produced.

According to the aggregations required by the NACE Rev. 2 classification pursuant to Regulation (EC) no. 1893/2006, the data produced in 2016 show the type of waste and the quantities produced are prevalently by the agricultural sector. For instance, the agriculture sector of Emilia Romagna illustrates that the main hazardous and non-hazardous waste are:

- Hazardous wastes: chemical wastes (46%) and exhausted oils (26.11%)
- Non hazardous wastes are common sludge (37%), plastics waste (6.4%), wood and plant residues (17%), faeces, urine and manure (5.2%).
- special waste is 10.2% of the total amount.

The specific challenges tackled by the projects are:

- There is a need to have a standardised product (fertilizer) for recognition as a fertilizer at EU level<sup>10</sup>.
- Along the Agro-food value chain, the pursuit of inorganic waste prevention in this sector requires a robust transformation in supporting food production and process re-manufacture, in terms optimising the use of materials and the re-design of products.
- To achieve zero inorganic waste in the Agro-food sector.
- The production of Struvite from slurry and biogas digestate to support the new marked fertilising products and amending Regulations (EC) No 1069/2009 and (EC) No 1107/2009

<sup>9</sup> [http://ec.europa.eu/environment/eir/pdf/report\\_it\\_en.pdf](http://ec.europa.eu/environment/eir/pdf/report_it_en.pdf)

<sup>10</sup> In the "European Parliament legislative resolution of 27 March 2019 on the proposal for a regulation of the European Parliament and of the Council laying down rules on the making available on the market of CE marked fertilising products" (first reading), it is written that

par 1. The Commission is empowered to adopt delegated acts in accordance with Article 44 (...)for the purposes (...) of facilitating internal market access and free movement for EU fertilising products: (a) which have the potential to be the subject of significant trade on the internal market, and (b) for which there is scientific evidence that they: (i) do not present a risk to human, animal or plant health, to safety or to the environment, and (ii) ensure agronomic efficiency.

## SOLUTIONS PROVIDED BY THE INTERREG MED GREEN GROWTH COMMUNITY PROJECTS

The achievement of circular economy solutions in the waste sector relies on the implementation of strategies and processes that can help to overcome the aforementioned challenges and to move the sector towards a circular economy. Some of the following strategies and solutions have been implemented that show how challenges can be overcome.

### Mapping and testing the Best Available Technologies and Methodologies

Datasets that are produced to map out the Best Available Technologies (BATs) and Key Enabling Technologies (KETs) and products help to identify the most promising zero-waste solutions. This is done through capitalising on previous project results, as well as results from research and innovation centers and international actors in relevant green sectors. REINWASTE demonstration actions offered to 30 companies from 3 value chains (meat in Sud-Provence-Alpes-Côte d'Azur, milk in Emilia-Romagna and horticulture in Andalusia) has provided knowledge on BATs and KETs that demonstrates sustainable and cost-efficient solutions. Some solutions identified for the horticultural sector are for instance bio-based materials, such as biodegradable strings for horticultural plots, compostable trays for fruit and vegetables packaging, the use of long lasting plastic covers, implementing new inorganic waste management models and inorganic waste traceability systems.

Further to the BATs and KETs, Action Plans to reach targets set by S3 (Smart Specialisation) for the agriculture and food industry and identification of other regional systems in the Mediterranean area provide the essential requirements to extend the advanced excellence scouting methodology developed by REINWASTE. Related targeted plans of transferability are also elaborated within the project.

### Pilots, Results and Key Success Factors

Project pilot actions are currently studying the level of effectiveness of the technology applied to the pilot plants to transform livestock waste into organic high-value commercial fertilizers (as Struvite), contributing to smart and sustainable growth and to the creation of new business and market opportunities (RE-LIVE WASTE). The RE-LIVE WASTE project outputs include 4 demonstrative Struvite Precipitation (SP) plants, and policy guidelines to stimulate innovation adoption and to set-up a common suitable legal framework.

Testing innovative products and technologies in pilot actions as part of the REINWASTE project, in 30 production companies and industries, will provide the companies with the most suitable advanced solutions to be introduced into their production chain to reduce inorganic

waste, including business and feasibility plans. For instance, in the horticultural greenhouse sector some bio-based materials can already be offered to substitute inorganic materials, such as biodegradable and compostable strings and clips for plant staking or biodegradable mulching plastic films. Other possibilities include the valorisation of difficult management wastes such as thin plastics, or the use of long-lasting plastic covers. Tests will bring back more sustainable and greener production systems. The sustainability analysis which includes a socio-economic, environmental survey, market analysis and feasibility study for launching a new REINWASTE service to systematize the offer-demand of innovative solutions.

Factors that are external to a project, programme or initiative within the circular economy ambit can vary from region to region, country to country, or indeed from sector to sector. These factors can include contextual variables such as: policy framework, stakeholder engagement, socio-economic situation, etc. With regards to the waste prevention and management in the Mediterranean the following factors have enabled projects to be successful.

- Inorganic waste is currently a very topical issue
- An Enabling Environment conducive to innovation including an existence of a European legal framework as well as in some EU countries
- Alignment of global issues to the projects' objectives
- Effective stakeholder engagement including the involvement and interaction of all the stakeholders in the value chain, who are sensitive to inorganic waste matter.
- Green Growth community to support knowledge sharing
- Support received from the financing organisation

A common approach of the projects of the Interreg MED Green Growth Community is to apply, test and validate solutions in sectors and regions, and thus provide evidence on what works in terms of promoting waste prevention and management and green growth in the Mediterranean region, in a manner that is highly context-specific and at the same time regionally scalable and replicable.

Together, the featured projects

- Implement activities in 5 Mediterranean countries: Cyprus, Bosnia-Herzegovina, Spain, Italy and France and with more than 100 actors.
- Test and put solutions into practice in 4 pilot applications and case studies
- Address 2 main circular economy issues in the Agro-food industry: Inorganic waste and livestock waste
- Focus on the attainment of 2 recent legislative changes.
- Number of SMEs involved (30?)

## Boxes on concrete results/examples

### ***An Enabling Environment conducive to innovation***

Waste prevention and management in the Mediterranean is afforded the opportunity to operate within a European legal framework. The ability to be working within a legal framework that allows for innovation and adaptation as well as innovative frameworks in some EU countries, pushes the adoption of legal measures within other member states and provides an enabling environment where innovation can take place. Furthermore, operating within a favourable context-policy framework, which is in the same direction as a waste prevention and management in circular economy project provides the grounds for innovation to occur. For instance, the current proposal for regulation to lay down the rules a CE mark for fertilizer products amending Regulations (EC) No 1069/2009 and (EC) No 1107/2009, now includes the recognition of fertilisers derived from livestock waste, as Struvite. This change in the enabling environment allows the sector to innovate and drive the circular economy process.

### ***Alignment of global issues to the projects' objectives***

One of the most relevant external factors is that waste (inorganic and organic) are topical issues, which results in an increase of awareness and interest by all stakeholders involved in the project, as well as external companies and stakeholders regarding the agricultural production and industrialization.

### ***Effective Stakeholder Engagement***

The involvement, interaction and effective engagement of all the stakeholders in the waste value chain, who are sensitive to inorganic waste matter (REINWASTE project example), makes it possible to approach the issue of waste from a multi-stakeholder point of view, this has guaranteed an integrative approach to the solutions ensuring the correct decision has been taken. The REINWASTE project also promotes improvement in the knowledge regarding the types and quantities of inorganic wastes produced in each value chain. This knowledge permits stakeholders to choose the best solutions to eliminate, substitute, recover or recycle these wastes. Furthermore, through promoting consumer awareness of the non-consumption of plastic packaging, such as to their reuse and recycling can lead to shared responsibility of the economic and environmental models.

The Interreg MED Green Growth Community modular projects within waste prevention and management (REINWASTE and RE-LIVE WASTE) focus on the two main areas facing waste generation problems: inorganic and organic (livestock) waste. Through engagement of stakeholders that cover the entire Agro-food value chain, and the close collaboration among many different partners in the implementation of

the projects together with the demonstration of innovative circular waste solutions provides the evidence that the transition towards a circular economy makes sense from an ecological and economic perspective.

## Circular Economy Monitoring Indicators

According to the European Commission's Monitoring Framework for the Circular Economy Action Plan adopted in 2018<sup>11</sup> there are two key challenges for the future in terms of waste management:

- (a) to reduce the levels of waste generation and
- (b) to align waste management objectives with those of the circular economy.

To achieve this, the EU have laid out the following Circular Economy targets

### Box : The EU Circular Economy Targets Related to Waste Management

- ✓ To reduce landfill to a maximum of 10% of municipal waste by 2030.
- ✓ To prepare 65% of municipal waste for re-use and recycling by 2030.
- ✓ To prepare 75% of packaging waste for re-use and recycling by 2030.
- ✓ To introduce waste prevention programmes.
- ✓ To develop a common EU methodology to measure food waste and define relevant indicators.
- ✓ To promote an efficient use of bio-based resources through a series of measures, such as guidance and dissemination of best practices of the cascading use of biomass and support for innovation in the bio-economy within the field of clean technology bio-waste and residues.
- ✓ To take action to encourage the recovery of critical raw materials, and prepare a report on best practices and options for further action at the EU level.

Furthermore, within the monitoring framework document, in terms of waste prevention and management, the indicators identified by the commission are:

- Waste generation (as an indicator for consumption aspects)
- Recycling rates (the share of waste which is recycled);
- Specific waste streams (packaging waste, biowaste, e-waste, etc.).

### Waste Generation

<sup>11</sup> European Commission (2018). Monitoring framework for the circular economy.

The EU municipal waste generation per capita has dropped by 8 % between 2006 and 2016 to an average of 480 kg per capita per year. The quantity of waste generated still correlates to a certain degree with GDP per capita. It is therefore positive that the data on total waste generation (including industrial and commercial waste but excluding major mineral waste) per unit of GDP shows a decrease of 11 % since 2006.

Within the Agro-food sector in the Mediterranean waste generation data (amount/volume and type of waste produced) can be obtained. For instance the REINWASTE project has obtained data from 3 strategic agricultural sectors in Europe (REINWASTE).

### ***Recycling Rates***

Between 2008 and 2016, EU recycling rates for municipal waste increased from 37 % to 46 %<sup>9</sup>.

Focusing on the Livestock sector in the Mediterranean, the recovery and transformation of livestock waste into Struvite for high-quality fertilizers can give an indication of recycling rates in this sector. Specifically, within the RE-LIVE WASTE project the installation of 3 new and 1 upgraded demonstrative Struvite Precipitation (SP) plants provides demonstrable indicators for this sector.

### ***Specific Waste Streams***

In terms of the indicators impacting also on the Agro-food sector, between 2008 and 2015, the recycling rates for packaging waste increased in the EU, from 62 % to 66 %; it increased in almost all Member States. For plastic packaging, the average recycling rate in the EU is significantly lower, at 40 %, even though there have been improvements in recent years<sup>9</sup>.

These indicators set by the European Commission have a main focus on municipal waste, however within the Agro-food sector data is generated to report against these indicators, for instance the total amount of waste treated and transformed per day per pilot plants (RE-LIVE WASTE) can be included within the waste generation indicators.

With the lack of specific indicators for one of the main industries in the EU (the food sector), there is a call to action to modify the current set of circular economy indicators. Building on the work of the Interreg MED Green Growth Community projects, the following indicators are proposed for monitoring the transition towards a circular economy with specific focus on waste prevention and management in the Mediterranean region. These can be applied at local, national and regional level.

- Best practices examples illustrating the avoidance of double packaging
- Increased number of enterprises using waste raw materials in their industrial processes
- Increased number of technologies available for the efficient recycling of waste/
- Increased number of enterprises recycling/ their waste in a profitable way.



- Increase of companies expenses in innovative solutions to minimize inorganic waste compared to the baseline
- Data on KPI as a result of the pilot actions carried out in production and industry companies, which can be used to estimate the willingness to restructure to greener production.
  - KPIs to include:
    - Number of companies implementing any technological or managerial/organizational solution within the project duration
    - Number of companies willing to implement any technological or managerial/organizational proposed solution
    - Investment costs to be mobilized by the companies to remanufacture their own productive system in the logic of inorganic waste minimization
    - Average RoI (Return of investment) of the proposed solutions
    - Increase of companies expenses in innovative solutions to minimize inorganic waste compared to the baseline
- Overall recycling rates, to include in the recycling rates other important waste/residue streams (Slurry; Biogas digestate from livestock waste)
- Recycling rates for specific waste.

## CONCLUSIONS AND CALL TO ACTION

Bringing about a paradigm shift in the Agro-food sector, as in the other economic sectors, has been accustomed to the take, make, waste linear model, is not an easy task.

To bring about changes, action is required, successful case studies are needed and achievable monitoring indicators are necessary to support the sector toward the circular economy model.

### A Call to Action from the Interreg MED Green Growth Community

The Interreg MED Green Growth community through the implementation of projects that are shifting from linear to circular economy models bring forward a call to action for consumers to policy makers to act on the following points.

- To bring forward positive change messages to consumers
- To better use/spread funds and subsidies
- To spread wider the different management models
- To continue to exchange experiences

#### Consumers

The management of inorganic waste is everyone's responsibility. Therefore, all the actors, which make up the different value chains, beginning with the producer and ending with the consumer, must respond jointly in respect to an environmentally friendly waste management solution.

## Companies (SMEs)

The key point should be to demonstrate that waste recycling is a profitable business and that the use of waste materials is more convenient than using raw materials. Furthermore, zero inorganic waste is the objective to pursue in Agro-food value chains, beginning by waste reduction, recycling, reuse and valorization of actions.

For companies (SMEs) that produce inorganic waste, such as farmers and Agri-industries, the key point should be to know and have available innovative solutions at sustainable costs in order to prevent the production of inorganic waste. In addition, it is necessary to have a network of widespread and efficient recovery plants that can make the recycling of inorganic waste advantageous from an environmental and economic point of view. Furthermore, it is necessary to ensure that the use of recycled material is safe and convenient compared to the use of raw materials.

## EU funding Agencies

It is recommended to make funds and subsidies available for the correct waste management as the first steps towards value chains restructuring and adaptation to greener practices in the Agro-Food industry.

## Policy Makers

More awareness regarding the correct waste management is necessary, along the whole value chain. Policy makers have the responsibility to support the industries and territories with effective policies oriented towards making a real change to a circular economy.

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## Contacts

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Contact: Mercè Boy Roura, University of Vic – Central University of Catalonia, [merce.boy@uvic.cat](mailto:merce.boy@uvic.cat) /  
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### RE-LIVE WASTE:

Website:

Contact:

### REINWASTE:

Website:

Contact:

## About the Interreg Med Green Growth Community and the SYNGGI Project

The Interreg MED Green Growth community is a thematic community of projects in the framework of the Interreg MED programme, which is a transnational European Cooperation Programme for the Mediterranean area. The Interreg MED Green Growth community counts with 15 projects working on different topics related to green growth such as sustainable agro-food systems, eco-innovation, green manufacturing, green public procurement, waste management and smart cities, among others.

The specific objectives of the Interreg MED Green Growth community are:

1. **Empowered Green Growth community for Mediterranean and non-Mediterranean stakeholders:** creation of a solid community that act as a hub to collect project results, disseminate and capitalize them among partners, consortia, stakeholders and countries.
2. **Upgrading Green Growth community networks:** the community creates bridges and seek collaboration with networks, institutions and programmes inside and outside the Interreg MED cooperation area to transfer the knowledge and results of the projects and to promote synergies among initiatives in the Mediterranean region.
3. **Capitalization Support:** capitalization and transfer activities are performed to outreach the project results and potential replication of projects to other countries. Common policy outcomes are produced to contribute to the vivid legal framework that needs constant revision and input.

It is the first time that in such an extended scale, more than 150 partners from the quadruple helix (public authorities, industry, academia and civil society) from 12 countries are exchanging knowledge in the field of green growth in the northern and eastern area of the Mediterranean region. The Interreg MED Green Growth community counts with partners from Albania, Bosnia-Herzegovina, Croatia, Cyprus, France,

Greece, Italy, Malta, Montenegro, Portugal, Slovenia and Spain. The total budget of the funded projects under the Interreg MED Green Growth community is of approximately 34 million Euros.

For the Green Growth thematic of the Interreg MED programme, SYNGGI – “Synergies for Green Growth Initiative – Energising the Impact of Innovation in the Mediterranean” is the project managing the Interreg MED Green Growth community (2016-2019). The SYNGGI project acts as a dynamic network to unify project results, support MED stakeholders and create a fruitful and collaborative environment for all implicated bodies. The methods that are used within that framework aim to stimulate sharing of project results and findings and enhance the cross-sectoral innovation practices among Mediterranean key stakeholders. The community disseminates the projects’ results and good practices to stakeholders and policy-makers from the Interreg MED cooperation areas and beyond. Moreover, strong emphasis is given in the capitalization process, with the objective to create common policy outcomes to contribute to the vivid legal framework that needs constant revision and input, such as the EU Circular Economy Action Plan and other environmental policies.

## PROJECT FACTSHEET

The following pages show the questionnaire and the Deliverable “Mapping of Modular Project’s transferrable results” developed by Dynamic Vision on behalf of Green Growth Community.



**Deliverable:**

# PROJECT FACTSHEET

Project co-financed by the European  
Regional Development Fund

**Partners:**



**Name of the project:** RE-LIVE WASTE “Improving innovation capacities of private and public actors for sustainable and profitable Recycling of LIVEstock WASTE”.

**Countries:** Bosnia and Herzegovina, Cyprus, Italy, Spain,

**Target Groups:** Sectoral agency; Business support organisation; Education / training centre and school; Enterprise, except SME; Interest groups; Farmers; Higher education and research, Research institutions and universities; Infrastructure and (public) service provider; International organization, EEIG; Local public authority; National public authority; Regional public authority and General public; environmental NGOs

**Green Growth Theme:** Waste management.

**Keywords:** Livestock waste management, struvite, struvite enriched precipitate (SEP), abatement of recovery of nitrogen alongside with phosphorous; small-scale pilot Struvite Precipitation (SP) plants

**Starting Date-Ending Date:** 01/02/2018-30/04/2021

**Budget:** 2.285.087,50

**Quote (max. 50 words):** Livestock breeding is a key sector in the MED economy. However, intensive cattle and pig farming has become a major source of environmental pollution. RE-LIVE WASTE investigates innovative solutions to transform livestock waste into organic high-value commercial fertilizers through nutrient recovery from highly polluted waste streams.

**Location of the project pilot studies:** the suburbs of Sarajevo (Bosnia and Herzegovina), Monagroulli (Cyprus), Arborea (Italy), and Castellón (Spain).



### **Project Description - What is \* RE-LIVE WASTE \* about?**

Agriculture and livestock breeding are key sectors in the MED area. Regions involved in the project are characterized by intensive cattle and pig farming, thus producing a large amount of waste that has become a major source of pollution, an environmental challenge for society, and an economic problem for farmers. There is a great untapped potential for MED regions to foster the use of innovative technologies that convert livestock waste into resource. RE-LIVE WASTE tests innovative solutions for livestock waste management in selected MED regions, considering technical, environmental, economic, and legal aspects. Project pilot actions will transform livestock waste into organic high-value commercial fertilizers (struvite and struvite enriched precipitate-SEP), contributing to smart and sustainable growth and to the creation of new business and market opportunities. Project outputs include 4 demonstrative Struvite Precipitation (SP) plants and policy guidelines to stimulate innovative approaches to policymaking and set-up a common suitable legal framework. The transnational network aims at sharing innovative technologies reducing the environmental footprint of livestock farming. A quadruple-helix and beneficiary-oriented approach will secure a tangible impact on the territories involved and the transferability of results to other EU regions.

### **What are the challenges to be addressed?**

RE-LIVE WASTE contributes to Europe 2020, addressing challenges related to R&D, innovation, energy, and climate change. The project will play a role in the regions' transition to a greener, environmentally friendly economy since the organic fertilizers that will be produced from the transformation of livestock waste are more efficient compared to energy-intensive mineral fertilizers, as they release very low GHG emissions throughout the production cycle.

### **What are the solutions and best practices proposed by the project?**

The small-scale pilot Struvite Precipitation (SP) plants will allow for the abatement and recovery of nitrogen alongside with phosphorous, thus helping farmers to comply with the EU Nitrates Directive, as well as improving the "Nutrient Use Efficiency" of the farming activities, therefore contributing to safeguarding the environment and promoting Green Growth.



The project will strengthen transnational and regional action strategies in waste management where transnational cooperation can contribute to improve regional and territorial practices. RE-LIVE WASTE also contributes to reach the EC objectives concerning the shift towards a resource-efficient economy, reduced GHG emissions, the protection of the environment, and supporting better environmental governance at all levels. The project is also in line with regional policies in the MED area that consider innovation as the key driver for competitiveness and growth, in line with the Regional Smart Specialization Strategies and contributing to the smart growth objectives of the Territorial Agenda 2020.

### **What are the project's lessons learnt and broader recommendations?**

The 4 pilot plants (3 newly installed and 1 upgraded plant) produced struvite from different effluents, that is, treated and untreated cattle and pig waste). Working with different types of starting material entailed specific difficulties that required the consortium to seek customized solutions and adjust different techniques in the production process. Process optimization not only allowed to reach higher level of purity, but also to gain knowledge on both the process and the operation of the pilots. The purity of the struvite produced in all pilots varied between 50% to 99.6%. It was also analysed for its chemical characteristics and for its heavy metal, pathogens content. In Cyprus, filtration of the anaerobically treated digestate through ceramic membranes resulted in an effluent free of pathogens, heavy metals, and carcinogens. Thus, the pre-treatment of the effluent used for struvite precipitation can affect the quality of struvite produced and its product marketability. Besides the quality characteristics of the end-product, it was important to prove its functionality as a fertilizer and it was compared with commercially available fertilizers in different crops. Two out of the four partners that have already completed the agreed agronomic protocol concluded that the struvite from those pilots could replace the conventionally produced fertilizers. Another important achievement of this project was that the nitrogen content of the treated effluent was significantly reduced, a major accomplishment for the project's territories since some of them are located in areas which are vulnerable to nitrates. The entire process was also evaluated from an economic and an environmental point of view.

Besides the technical aspects, the project focused on preparing suggestions for policy guidelines regarding struvite usage and marketability within the EU, which were shared



during the round tables with the stakeholders of each country. Transferring activities through workshops, open-door events, and online seminars took place throughout the duration of the project, so that acquired knowledge was shared with the interested parties including farmers, local and national authorities, and scholars. Based on the feedback received their interest in the project was very high.

The project's outputs together with the transferring activities allowed the consortium to get even more in touch with the needs of the farmers and the policymakers who are interested in finding eco-friendly solutions for livestock waste management.

The project's recommendation is to continue exploring different techniques for struvite production (to the ones tested herein) as well as pre-treatment technologies that can enhance the process of struvite production. Another recommendation is to better understand to which extent struvite production can be combined with other techniques and technologies for nutrient recovery. The project showed that solutions must be tailored to specific conditions (technical, economic, legal, etc.). Mapping all the potential solutions and understanding how they better fit together will allow a more effective response to stakeholders' needs and a faster adoption rate. This complex problem allows for different perspectives to be applied. One of the greatest strengths of the RE-LIVE WASTE project is certainly the different backgrounds of the partnership and the strong devotion to the project and its implementation.

### **How is this project contributing to Green Growth and the EU Green Deal?**

RE-LIVE WASTE contributes to the Green Growth priorities by promoting the achievement of sustainable development in the Med area. The project aims at fostering the reuse of livestock waste by transforming it into a high-value commercial fertilizer, while focusing on cost-effective ways for reducing its environmental impacts.

In particular, RE-LIVE WASTE will contribute to the "Farm to Fork Strategy designing a fair, healthy, and environmentally-friendly food system"<sup>1</sup>. By processing waste, the pilot plants

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<sup>1</sup> 2.1.6. From 'Farm to Fork': designing a fair, healthy and environmentally friendly food system. European food is known to be safe, nutritious and of high quality. It should now also become the global standard for sustainability. Although the transition to more sustainable systems has started, feeding a fast-growing world population remains a challenge with current production patterns. Food



will contribute to the reduction of the leaching of nitrates into groundwater and the accumulation of excess nutrients and heavy metals in the soil. Furthermore, the liquid effluent produced at the end of the production process might be used for fertigation, reducing the amount of fresh water used in the farms.

From an industrial point of view, the small-scale plants will contribute to reducing the use of raw materials. With industrial phosphorus fertilizers being manufactured from phosphate rocks which are non-renewable resources and currently jeopardised by depletion, P-recovery (along with nitrogen) from nutrient organic waste has the potential to become common practice. The project seeks to produce high-value bio-fertilizers while recycling livestock waste and recovering nutrients.

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**Social Media channels:** <https://twitter.com/relivewaste>  
<https://www.facebook.com/relivewaste>

**Project links of interest:**

**Project partners:**

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production still results in air, water and soil pollution, contributes to the loss of biodiversity and climate change, and consumes excessive amounts of natural resources, while an important part of food is wasted. At the same time, low quality diets contribute to obesity and diseases such as cancer. (<https://eur-lex.europa.eu/legal-content/EN/TXT/DOC/?uri=CELEX:52019DC0640&from=IT> document n.1 page 11)





ITALY	University of Sassari
	Sereco Biotest di Bilenka Oksana s.a.s.
	Laore- Regional Agency for Agriculture Development
SPAIN	FGN-Fundación Global Nature
	Alia- Agricultural Transformation Society
	LA UNIÓ De Llauradors I Ramaders Del Pais Valencia
CYPRUS	CUT- Cyprus University of Technology
	Ministry of Agriculture, Rural Development and Environment - Department of Environment
B&H	Sarajevo Economic Regional Development Agency SERDA
	University of Sarajevo -Faculty of Agriculture and Food Sciences
Associated partners	
Armenis Nicos & Sons Ltd	Cyprus
PD Butmir	Bosnia and Herzegovina
Arborea Producers' Cooperative – Agricultural Corporation	Italy



**Please provide all partners' logos in high-quality resolution, as well as 6- 8 high quality, visually impactful photos of your project that are representative of its thematic focus and concrete results. You can upload the photos and logos to your project folder [here](#).**



Project co-financed by the European Regional Development Fund

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# RE-LIVE WASTE

Production of organic high-value commercial bio-fertiliser, struvite



## Countries:

Spain, Cyprus, Italy and Bosnia and Herzegovina

## Target Groups:

Sectoral agencies, business support organisations, enterprises except SMEs, interest groups, European Economic Interest Grouping, farmers, Higher education and research, research institutions and universities, training centres and schools, infrastructure and (public) service providers, international organisations, local public authorities, national public authorities, regional public authorities, the general public

## Theme:

Waste management

## Key Words:

Livestock waste management, struvite, struvite enriched precipitate (SEP), abatement of recovery of nitrogen and phosphorus, small-scale pilot Struvite Precipitation (SP) plants

## Starting and Ending Dates:

February 2018 -  
January 2021

Agriculture and livestock breeding are key sectors in the Mediterranean region. Regions involved in the project are characterised by intensive cattle and pig farming, thus producing large amounts of waste that have become a major source of pollution, creating both environmental and economic challenges. There is an untapped potential for farmers in the Mediterranean to use innovative technologies to convert livestock waste into a resource. **RE-LIVE WASTE** tests innovative solutions for livestock waste management in selected Mediterranean regions, exploring the technical, environmental, economic, and legal aspects of fertiliser production. Pilot projects

transform livestock waste into organic high-value commercial fertilisers (struvite and SEP), contributing to smart and sustainable growth and to the creation of new business and market opportunities. Project outputs include 4 Struvite Precipitation (SP) plants, policy guidelines to stimulate innovative approaches to policy making, and establishment of a common legal framework. This transnational network aims to share innovative technologies that reduce the environmental footprint of livestock farming. A quadruple-helix and beneficiary oriented approach will ensure a tangible impact on the territories involved and the transferability of results to other European countries.

**Improving innovation capacities of private and public actors for sustainable and profitable Recycling of LIVestock WASTE.**

## RE-LIVE WASTE Pilot Projects



## Challenges

**RE-LIVE WASTE** contributes to the Europe 2020 strategy, addressing challenges in research and development, innovation, energy management, and climate change. This project supports the region's transition to a

greener economy, because the organic fertilisers produced from livestock waste are more efficient than energy-intensive mineral fertilisers, and release less GHG emissions during the production cycle.

## Solutions

The small-scale pilot Struvite Precipitation (SP) plants will allow the recovery of nitrogen and phosphorus, allowing farmers to comply with the EU Nitrates Directive (1991) as well as improving the 'nutrient use efficiency' of farming, contributing to environmental protection and green growth.

The project will strengthen transnational and regional action strategies in waste management.

**RE-LIVE WASTE** also contributes to the objectives of the LIFE Programme (2014-2020) concerning the shift towards a resource-efficient economy, reduced GHG emissions, and improving environmental governance at all levels. The project is also in line with regional Mediterranean policies that consider innovation as the key driver for competitiveness and growth, such as the Territorial Agenda 2020.

## Lessons learnt and broader recommendations

The lessons learned and the recommendations will be part of a specific deliverable of Activity 3.7. It is important to note that one facility (CY) was able to produce high purity struvite (~90%), which was free of pathogens and carcinogens. This particular struvite was compared with commercially available fertilisers and the results appear to be very promising. Additional methodologies to address different needs (i.e. farmers

vs. companies) are currently being tested. This has made it clear that a flexible approach to livestock waste transformation is essential for developing an effective strategy. This stems from the diversity of livestock breeding and feed that results in a variety of waste materials which require fine-tuning of pilot plants according to the quality of the materials to be treated.

## Green Growth and the EU Green Deal

**RE-LIVE WASTE** contributes to Interreg MED Green Growth's priorities by creating tangible options for sustainable development in the Mediterranean region. In particular, **RE-LIVE WASTE** will contribute to the 'Farm to Fork Strategy' for designing a fair, healthy, and environmentally-friendly food system<sup>1</sup>. By processing waste, the pilot plants will reduce the leaching of nitrates into groundwater and the accumulation of excess nutrients and heavy metals in the soil. Furthermore, the liquid effluent pro-

duced at the end of the production process might be used for fertigation, reducing the amount of freshwater used on these farms. From an industrial point of view, livestock waste reutilisation will reduce the use of raw materials. Industrial phosphorus fertilisers are manufactured from non-renewable phosphate rocks which are near depletion. Phosphorus recovery (along with nitrogen) from organic waste has the potential to become common practice, which is what the **RE-LIVE WASTE** project seeks to achieve.

### The InterregMED Green Growth Community

Green Growth is a thematic community that promotes sustainable development in the Mediterranean within the framework of the Interreg Med Programme. It supports the sound management of natural resources by enhancing cross-sectoral innovation practices through an integrated, territorially-based cooperation approach.

The community supports its projects in communicating and capitalising on their results to increase their impact at the policy level and ensure their potential transfer into other territories.

Visit our website:

[green-growth.interreg-med.eu](https://green-growth.interreg-med.eu)

Join the Green Growth Capitalisation Platform:  
[interregmedgreengrowth.eu](https://interregmedgreengrowth.eu)

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**Social Media Channels:**





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## RE-LIVE WASTE

### Type of the result:

- Methodology
- Guidelines
- Policy recommendations

### Language(s) in which the result is developed:

- English
- Spanish
- Italian
- Serbo-Croatian
- Greek

### What is the most appropriate level for its use/ implementation?

Local, regional, national  
and international

## DESCRIPTION OF THE RESULTS

Improper livestock waste management pollutes surface water (eutrophication and the addition of micropollutants) and accelerates climate change, through the emission of greenhouse gases. During the **Re-Live Waste** project, livestock waste was used to produce high-value bio-fertilisers by recovering nutrients from heavily polluted streams. To do so, four pilot plants (of which one was upgraded) were installed to incorporate innovative techniques in Italy, Cyprus, Spain, and Bosnia and Herzegovina, using treated and untreated slurries as raw materials to produce bio-fertilisers.

The processes involved the crystallisation of an organo-mineral fertiliser with isomolar ratios of magnesium, ammonium, and phosphate and chemical formula  $\text{NH}_4\text{MgPO}_4 \cdot 6\text{H}_2\text{O}$ , called struvite. Struvite is a slow nutrient releaser, allowing it to fertilise crops more efficiently than conventional formulas, while creating fewer pollution streams.

It is produced by adding excess amounts of  $\text{Mg}^{+2}$  compared to ammonium and phosphate which cause supersaturation of the solution and result in struvite precipitation. In this case, raw slurries and anaerobically treated effluents were used to produce struvite.



## PROJECT IMPLEMENTATION AND EVALUATION BY END-USERS

The results have been tested in Cyprus, where the SCR was successfully operated and produced high-quality struvite in terms of physical-chemical characteristics and purity, absent from pathogens and carcinogens.

The product also underwent agronomic evaluation and was compared with fertilizers commonly used for growing lettuce, radishes, and *Lepidium sativum* L. in greenhouses, with promising results.

## WHAT IS THE TRANSFER POTENTIAL?

Transferability of this outcome relies on improving the innovation capacities of the public and private actors involved in livestock waste management and farming, and we are aiming to strengthen the cooperation between the quadruple helix actors. In parallel to the technological aspects, several actions have been put in place to ensure the project's transferability. Public events (such as open days, technical visits, workshops and round tables) are effective mechanisms to reach stakeholders across the value chain. Simple communication tools such as exhibition panels or informational documents (easy guides for complex issues) have been combined with more elaborate documents such as the policy guidelines, to achieve maximum transferability from laymen to decision makers.

## WHAT IS THE PROJECT REPLICABILITY?

The quality of the struvite produced depends on the treatment process. Each pilot case had different feed characteristics, budget, type of reactor, etc., so each partner produced struvite of different quality. However, each solution is solid and replicable. This was proven by the pilot site in Cyprus – the most advanced of the pilot sites – where five experiments have been carried out, with the quality of struvite produced consistently above 70.5% (considerably high based on the starting material). If the model is transferred to other regions as it is, and all parameters remain the same, then the plan will perform the same way.

This project tests different scenarios for struvite production. In all the cases, there was a solution for struvite production and a more sustainable waste management, despite differences in raw material, farm structures, plant managers, etc.

The struvite produced can be used for agriculture, as well as for fertilising private home gardens. The process of struvite production can be applied in small- or large-scale farms as a step towards meeting EU regulations and reducing fines for private use.

## WHAT CHALLENGES MAY ARISE?

The biggest challenge that in struvite production is the level of investment. The higher the investment, the greater the quality of struvite will be. It is possible to keep the initial investment cost low and 'polish' the wastewater effluents produced from a farm, but the struvite enriched precipitate (SEP) produced will be most appropriate for domestic use. The important thing is for investors to choose their business model and set the minimum viable product (MVP). When it comes to accessing the data of large-scale applications, a PLC and SCADA system must be installed for automatic operation and remote monitoring respectively, but personnel are still needed for maintenance. There is no one solution for farm-level struvite production, but there are a variety of solutions based on the same principle. The challenge is to understand the value chain (substrate, volume, farm structure, legal support, local grants, etc.) and to adapt the plant to its context.