This project has received funding from the EU Horizon 2020 research and innovation programme under grant agreement No. 690323

Current nutrient research – what is going on – R&D projects flash presentations

3rd EUROPEAN NUTRIENT EVENT @ ECOMONDO 2018

European Sustainable Phosphorus Platform (ESPP)
Kimo van Dijk – kimovandijk@phosphorusplatform.eu

8 - 9 November 2018, Rimini, Italy

European Sustainable Phosphorus Platform

This project has received funding from the EU Horizon 2020 research and innovation programme under grant agreement No. 690323

SMART-Plant

Italian Phosphorus Platform

15 ANNI GRUPPO HERA

ECOMONDO THE GREEN TECHNOLOGIES EXPO 22ª Fiera internazionale del recupero di materia ed energia e dello sviluppo sostenibile

Green & Circular Economy 6-9 Novembre 2018 Rimini Italy IN CONTEMPORANEA CON KEY ENERGY

ESPP catalogue of research projects on nutrient recycling and stewardship

- *Running and finished projects, including: name, summary, funding sources, start and end date, website, contact person and contact details*
- *Funding sources: EU H2020 (FP), LIFE, INTERREG, national / industry / university funded R&D projects on nutrient recycling and stewardship*
- *The full ESPP R&D project catalogue and more information can be found on the R&D activities page of ESPP: www.phosphorusplatform.eu/R&D*
- *Please correct and add projects, see document what information is required.*
- *Please send your question and input to Kimo van Djik (kimovandijk@phosphorusplatform.eu)*

This project has received funding from the EU Horizon 2020 research and innovation programme under grant agreement No. 690323

The following research projects on nutrient recycling and stewardship will present

	Acronym	Presenter	Email
1	BEST	Paula Lindell	paula.lindell@hsy.fi
2	BiofuelcellAPP	Andrea Goglio	andrea.goglio@unimi.it
3	Circular Agronomics	Victor Riau Arenas	victor.riau@irta.cat
4	DOP	Giuliana D'Imporzano	giuliana.dimporzano@unimi.it
5	HYDROUSA	Simos Malamis	smalamis@central.ntua.agr
6	INCOVER	Peder Gregersen	psg@pilerensning.dk
7	MEMORY / Innovation Deal	Aurora Seco	Aurora.Seco@uv.es
8	MIND-P	Simona Sharma	simona.sipaviciute@ntnu.no
9	NEWBIES	Mariana Rodrigues	Mariana.Rodrigues@wetsus.nl
10	No_Waste	Sónia Rodrigues	smorais@ua.pt
11	NuReDrain	Pieter Van Aken	pieter.vanaken@kuleuven.be
12	P-Al/Fe-WTR	Iris Zohar	Irisz@migal.org.il
13	PeGaSus	Paolo Sckokai	paolo.sckokai@unicatt.it
14	RAVITA	Paula Lindell	Paula.Lindell@hsy.fi
15	Run4Life	Nicolas Morales Pereira	nicolas.morales.pereira@fcc.es
16	SABANA	Giuliana D'Imporzano	giuliana.dimporzano@unimi.it
17	SaltGae	Robert Reinhardt	robert@algen.si
18	SYSTEMIC	Inge Regelink	inge.regelink@wur.nl
19	Trialkyl	Maria Cristina Pasi	mc.pasi@italmatch.com
20	Vitisom	Federico Sambo	federico.sambo@unimi.it
21	ViviMag	Leon Korving	Leon.Korving@wetsus.nl
22	Water2REturn	Robert Reinhardt	robert@algen.si

Paula Lindell 8.11.2018

BEST – Better Efficiency for Industrial Sewage Treatment

Duration: 1.10.2017 – 30.9.2020

@BestBalticBSR

1) Assessment of the current situation
2) Capacity development
3) Local cooperation models and investments
4) Final outcome:
National and BSR wide guidelines for improved management of industrial effluents

Our BEST aim:
Promote cooperation and best practices between **industries, waste water treatment plants and local environmental authorities** to ensure efficient treatment for industrial waste waters in the Baltic Sea Region.

City of Helsinki
Kajsa Rosqvist, Project manager
Kajsa.rosqvist@hel.fi

EUROPEAN UNION
EUROPEAN REGIONAL DEVELOPMENT FUND
Interreg Baltic Sea Region
EU STRATEGY FOR THE BALTIC SEA REGION FLAGSHIP

e-BioCENTER
Research center on microbial electrochemistry

Università degli Studi di Milano

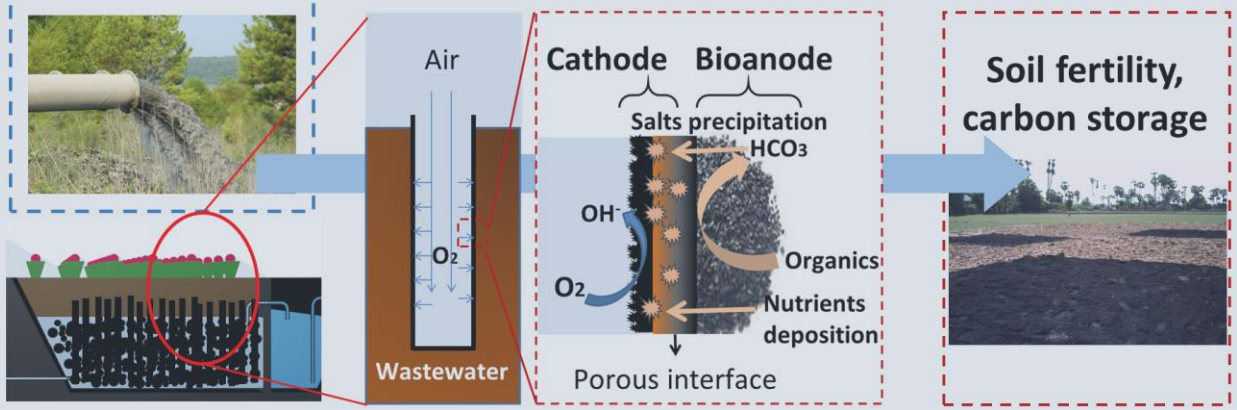
Scaling-up APPlicative microbial electrochemical technologies for agro-industrial wastewater recovery

PI: Dr. Andrea Schievano
andrea.schievano@unimi.it

e-BioFuelCell APP

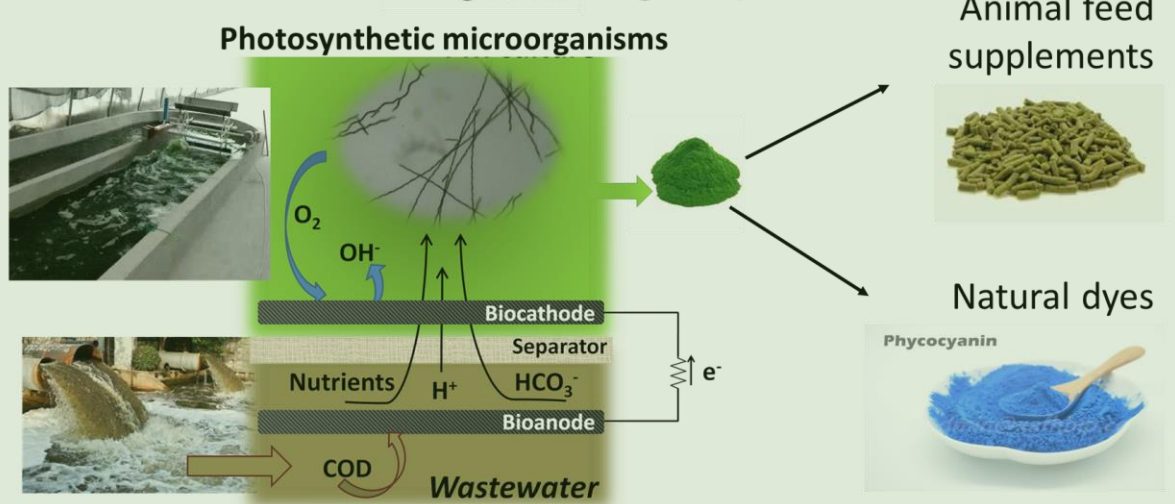
Project duration:
Sept. 2015 - Sept. 2019

e-BioNEWtrients



Fully-recyclable biochar-based METs modules, used in constructed wetlands for nutrients and carbon capture and recycling

e-BioPond®



METs-assisted raceway ponds for nutrients recovery and added-value microalgae-based products

Project (RBSI14JKU3) financed by the SIR2014 Grant, Italian Ministry of University and Research (MIUR).

Efficient carbon, nitrogen and phosphorus cycling in the European agri-food system and related up- and down-stream processes to mitigate emissions

01/09/2018 – 31/08/2022

OBJECTIVES

- **Increase the understanding of C, N, P flows** and the related potential to reduce environmental impacts (…)
- **Closing loops** within cropland farming, from livestock to cropland farming.
- **Increase the reuse of waste/wastewater** from food-industry to improve soil fertility and to increase nutrient use efficiency.
- **Highlight the performance** of different prototypes **and increase sustainability** of food production in the EU (…)
- **To contribute to the improvement of the European Agricultural Policies** (…)

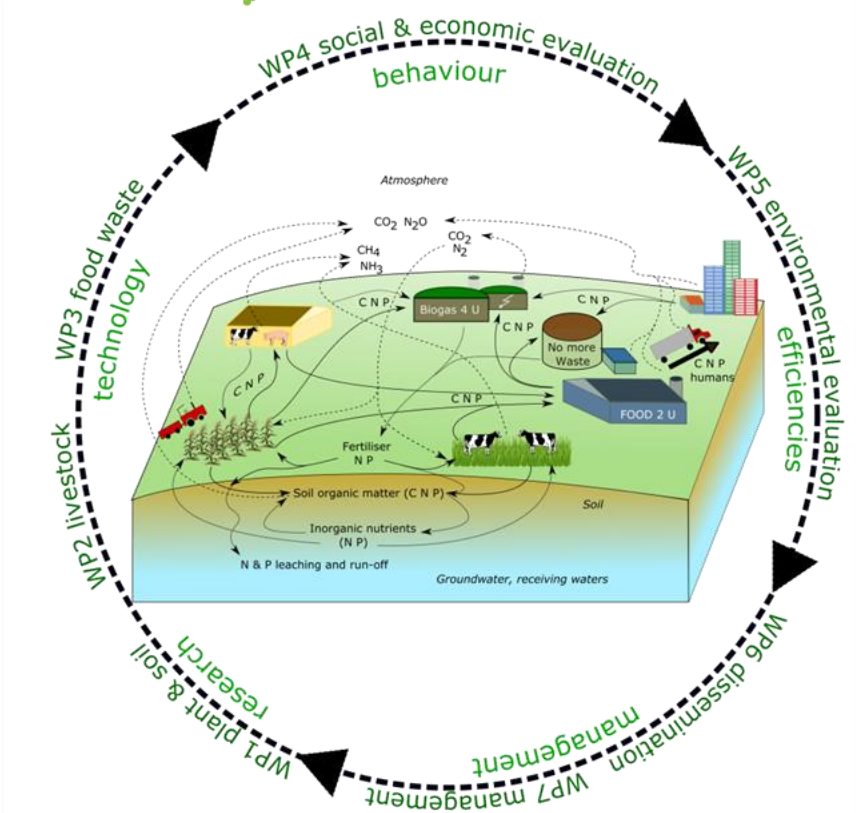
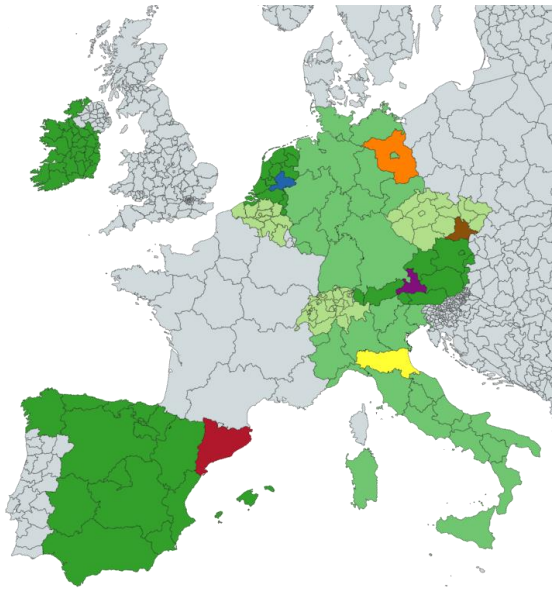


Image: Nellie Hobley (TUM)



Grant Agreement No 773649

LIFE DOP - Demonstrative mOdel of circular economy Process in high quality dairy industry

Start: 9/2016
End: 2/2021

Implement a demonstration model using innovative and **sustainable practices** from **feed** production in the field to stable and **manure management** for the production of Parmigiano Reggiano and Grana Padano cheese

Objectives and results contributing to nutrient recycling and management in the proposed model:

Implement AD of slurry to increase nutrient management efficiency

Implement proper distribution of liquid digestate in the cheese district (high efficiency)

No use of synthetic fertilizers

Export of solid digestate to non-breeding areas

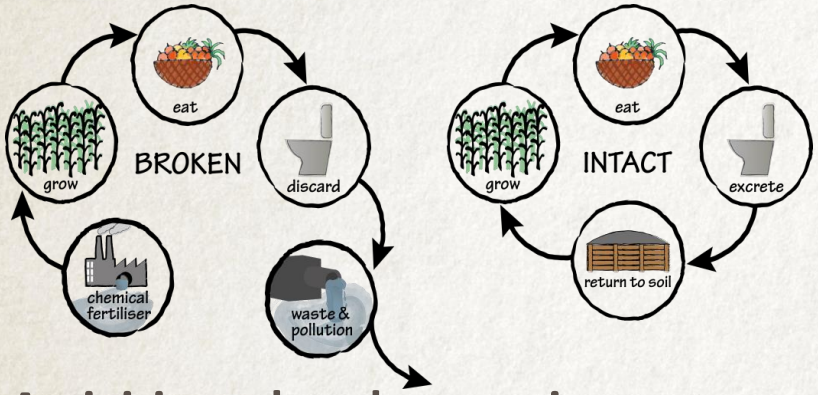
Manage slurry by an on line stock exchange platform to re-balance nitrogen load and create value

Implement LCA to asses the save of impacts of the proposed model with respect to the reference.

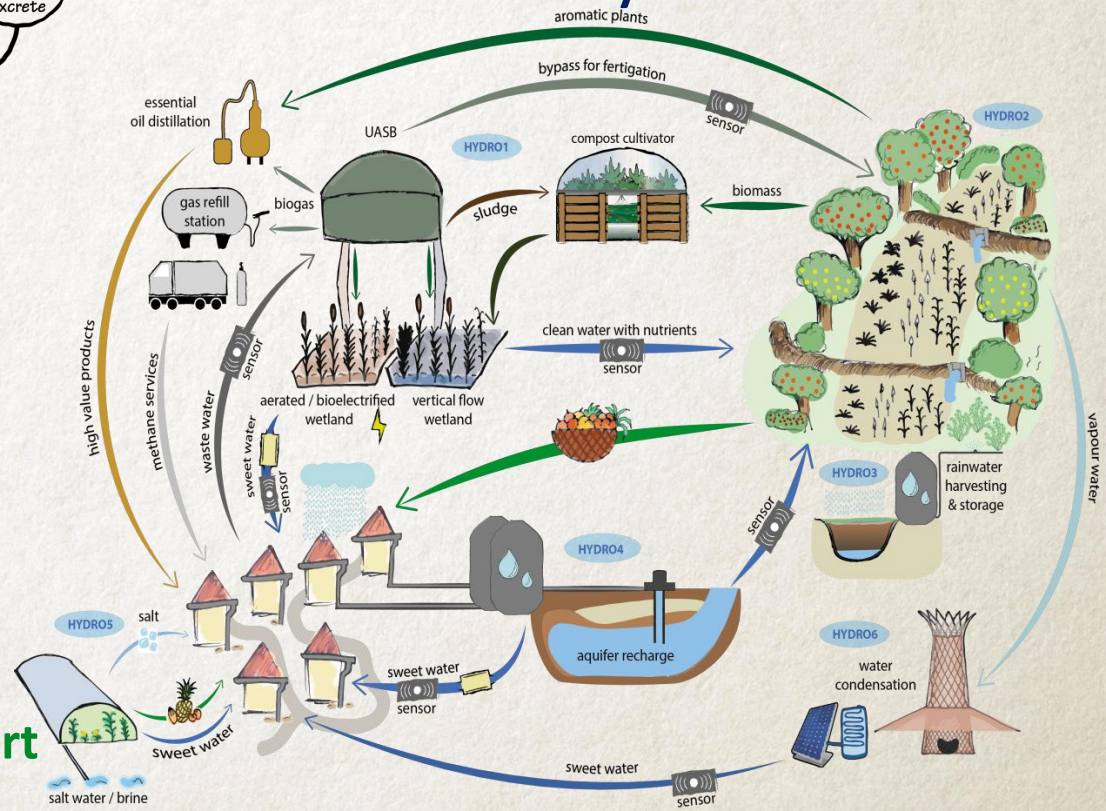
HYDROUSA

Demonstration of water loops with innovative regenerative business models for the Mediterranean region

Duration
Start: 1/07/2018
End: 31/12/2022



Challenge: Valorise non-conventional water sources through innovative water cycle solutions



Activities related to nutrient management

- **Integrating anaerobic treatment and nature based solutions for wastewater treatment, energy recovery and nutrient recycling**
- **Fertigation of an agroforestry**
- **Smart irrigation systems**
- **100% decrease of fertilizer import**

This project has received funding from the European Union's Horizon 2020 research programme under grand agreement No 776643

INCOVER

Innovative Eco-Technologies for Resource Recovery from Wastewater

INCOVER Project (GA: 689242):
June 2016 – May 2019

Target: Waste stream into a source of new added-value bio-products through 3 case-studies at demo scale.

Nutrient recovery activities:

- To validate P and N adsorption technologies from wastewater using innovative adsorbent materials

- To demonstrate nature-based processes and a hydrothermal carbonization technology to produce bio-fertilizer

- Smart solar disinfected water with excess nutrients and sensor networks irrigation technology

INCOVER Consortium

aimen CENTRO TECNOLÓGICO · AARHUS UNIVERSITET · aqualia · AUTARCON Pure. Simple. Solid. · Center for Recirkulering · Universidad de Valladolid · HELMHOLTZ CENTRE FOR ENVIRONMENTAL RESEARCH – UFZ

http://incover-project.eu

UNIVERSITAT POLITÈCNICA DE CATALUNYA BARCELONATECH · iBET · RENERGIE SYSTEME · FTN Future Intelligence TELECOM ENGINEERING COMPANY · SolarSpring · simbiente Engenharia e Gestão Ambiental · Office International de l'Eau · DANISH TECHNOLOGICAL INSTITUTE · ICLEI Local Governments for Sustainability · biotrend · isle

http://www.life-memory.eu

INNOVATION DEAL on Sustainable Wastewater Treatment Combining Anaerobic Membrane Technology and Water Reuse

Prototype scale AnMBR

Bioenergy

Biosolids

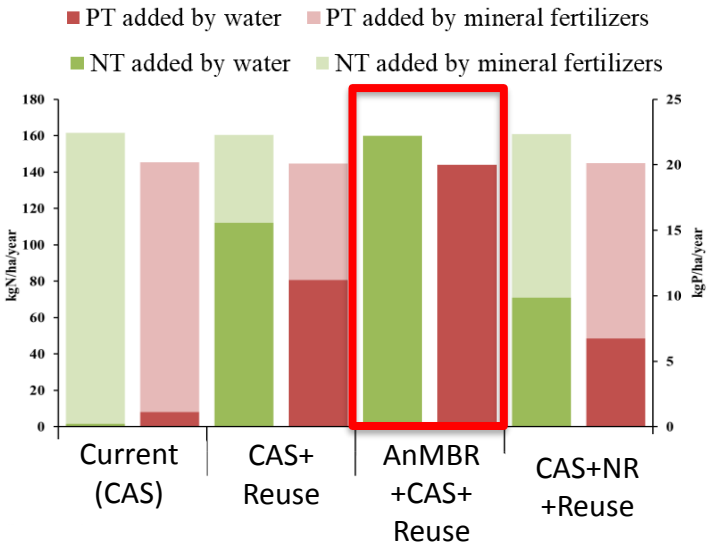
Effluent

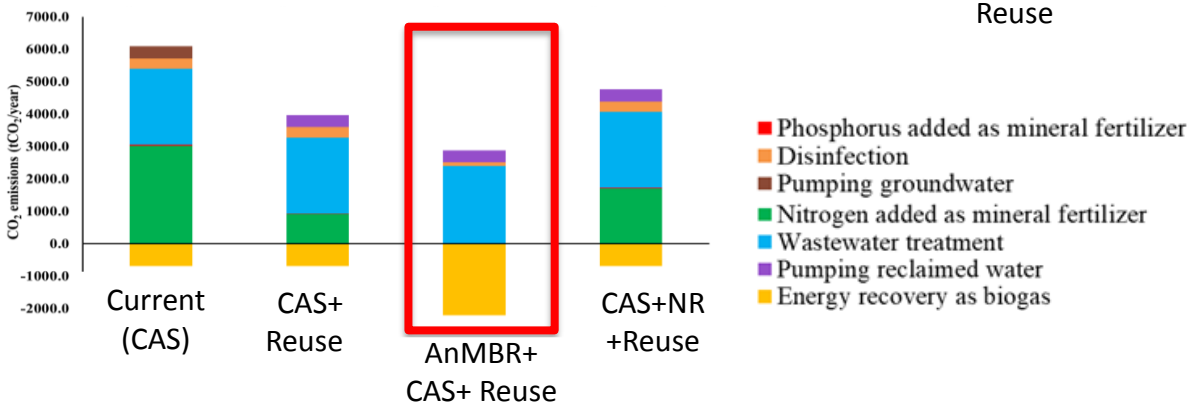
The most sustainable option

FERTIGATION for Nutrient Recovery

BUT Bottlenecks

Peschiera Borromeo





Aurora Seco Torrecillas

UNIVERSITAT POLITÈCNICA DE VALÈNCIA
Cal Agua Unidad Mixta UV-UPV
VNIVERSITAT DE VALÈNCIA

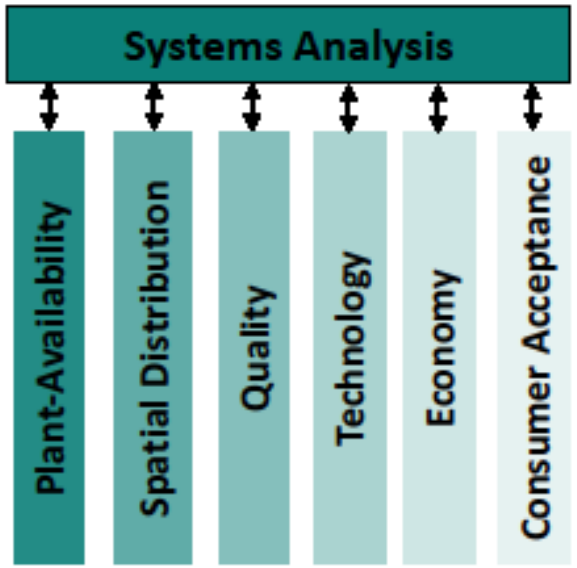
MIND-P

Nutrients in a Circular Bioeconomy: Barriers and Opportunities for Mineral Phosphorus Independence in Norway
Funded by the Research Council of Norway
Period: 2017 - 2020

Objective: Analyze pathways towards mineral P independence in Norway through improved recycling with a focus on manure and fish sludge.

Achieved through:

- **Estimating local secondary P supply potential**
- **Analyzing the key barriers and opportunities for utilizing this potential**
- **Testing different strategies and technologies in model simulations and scenarios developed in close collaboration with key stakeholders**



Barriers that need to be overcome through implementation into a systems context

NTNU Industrial Ecology

NTNU
Norwegian University of Science and Technology

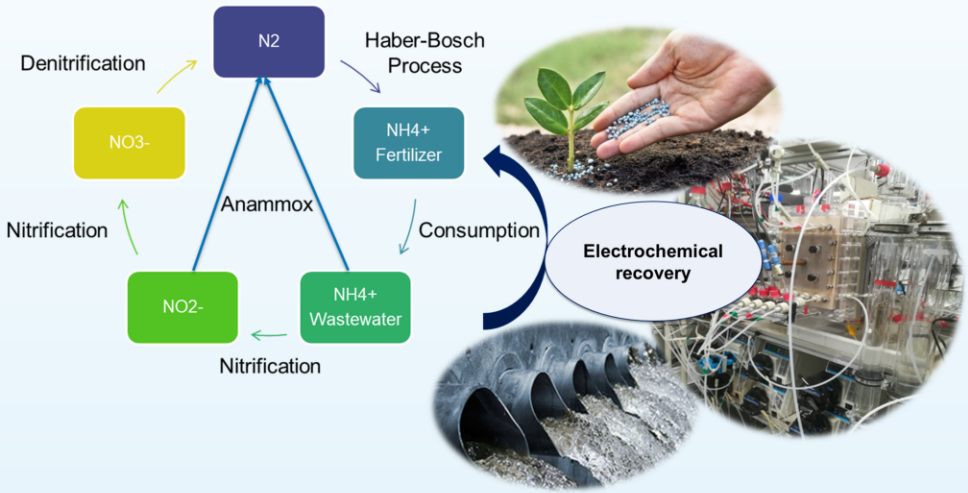
NIBIO
NORSK INSTITUTT FOR BIOØKONOMI

Technical University of Denmark
DTU

Nitrogen Extraction from Water By an Innovative Electrochemical System

Background

The intensive use of fertilizers in EU region is degrading sensitive water bodies. When the nutrients make their way into rivers, they considerably disturb aquatic ecosystems. Recycling the reactive nitrogen could reduce the energy needed to both produce and dispose of fertilisers, cutting greenhouse gas emissions on both ends of their production chain.



Objectives

- Demonstrate a novel technique to extract ammonium.
- Develop a pilot system capable of recovering from different wastewater in an economic, effective and energy-efficient way.
- Evaluate the economic and environmental impact by comparing with the existing nitrogen removal technologies.
- Select strategic partners to ensure a market for the produced fertilizer.

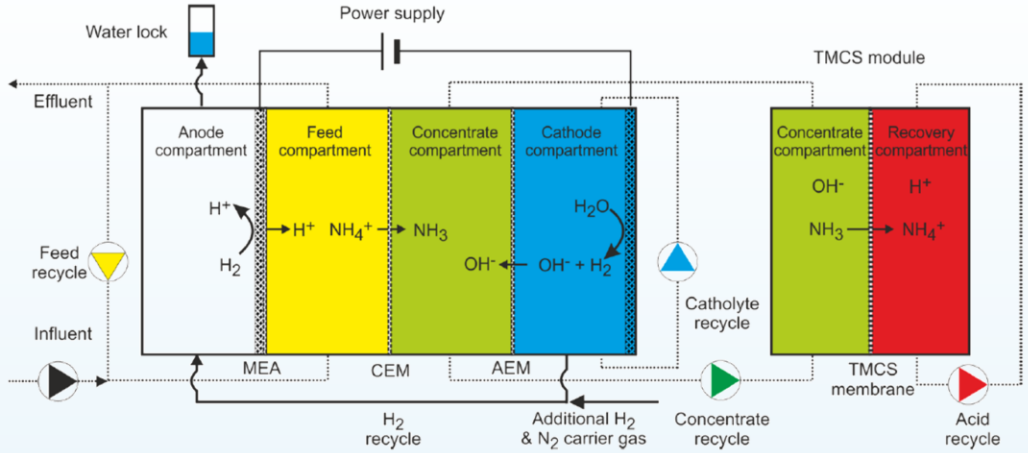


Fig 1. Scheme of the up-scaled electrochemical system for ammonia-nitrogen recovery.
Source: P. Kuntke et. al, Journal ACS Sustainable Chemistry & Engineering (2018) 7638-7644.

Expected Results

1 kg_N per day — Remove over 90% of the nitrogen present in the waste streams

Low cost of N per kg — Reduce the energy consumed by the process to under 16 MJ per kg of nitrogen recovered

Marketable product — Produce a nitrogen compound that is pure enough to reuse as fertilizer in agriculture

Mariana Rodrigues, Mariana.rodrigues@wetsus.nl
Contact: *dr. Phlipp Kuntke, Philipp.kuntke@wetsus.nl*

Info: newbies.eu
Project Schedule: July 2018 – June 2021

Management of Biomass Ash and Organic Waste in the recovery of degraded soils: A Pilot Project set in Portugal

Jan 2016 to Dec 2019

No Waste

http://www.lifenowaste.pt

AIM

Demonstrate the sustainable use of biomass ash combined with organic wastes (from the pulp and paper industry) to recover degraded soils from mining areas

Expected Results:

- **Prepare new ash-based soils improvers** (liming agent and macronutrient fertiliser)
- **Pilot Field Application**: determine **liming capacity; agronomic value**; **plant nutrients' availability**; **salinity**; **potential plant stress**
- Address **environmental and human health** protection issues
- Assess market potential and provide a technical framework for the **large-scale application** of ash-based soil improvers (Revised EC Fertiliser Regulation (2003/2003))

universidade de aveiro · THE NAVIGATOR COMPANY · edm Empresa de Desenvolvimento Mineiro, SA · RAIZ · IPBeja Instituto Politécnico de Beja · BLC3 Campus de Tecnologia e Inovação

Interreg
North Sea Region
NuReDrain

Phosphorus recovery potential and fertilizer value of recovered materials

Field demonstrations of nutrient filter systems

Nutrients Removal and Recovery from Drainage Water

Start Date: March 2017
End Date: September 2020

Bench scale evaluation of nutrient filter systems

Raf Dewil, Nico Lambert, Sofie Houtmeyers & Pieter Van Aken
KU Leuven - Process and Environmental Technology Lab
raf.dewil@kuleuven.be - www.northsearegion.eu/nuredrain

KU LEUVEN

P-Al/Fe-WTR

Phosphorus capture, recycling and utilization for sustainable agriculture and a clean environment using water treatment residuals (WTRs)

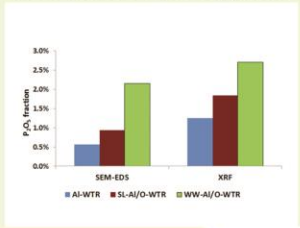
MIGAL Galilee Research Institute

Contact:
Iggy Litaor
litaori@telhai.ac.il
Iris Zohar
Irisz@migal.org.il

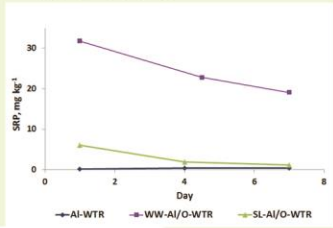
Objectives: To recover P, from agro-waste streams, using Al-water treatment residuals (Al-WTRs) or iron desalinization residuals (Fe-WTR). This would address both future P scarcity and environmental pollution.

Results: Both Al-WTR and Fe-WTR have a great potential to capture P from dairy wastewaters that contain 10s mg P L^{-1} and subsequently release it when applied as a fertilizer. Screenhouse experiments indicated the P-enriched Al-WTR and Fe-WTR successfully supported plant growth (lettuce as a test crop) similar to the commercialized granular and liquid P fertilizers.

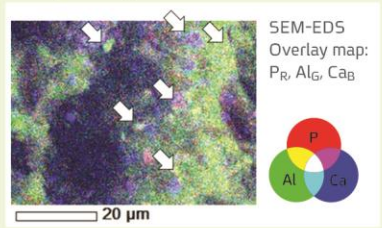
P surface accumulation associated with organic C

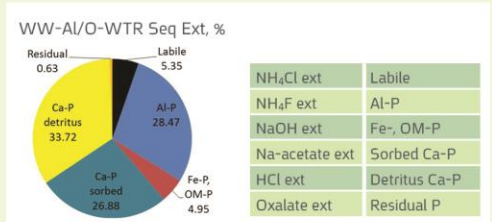


P improved release from Al/O-WTRs

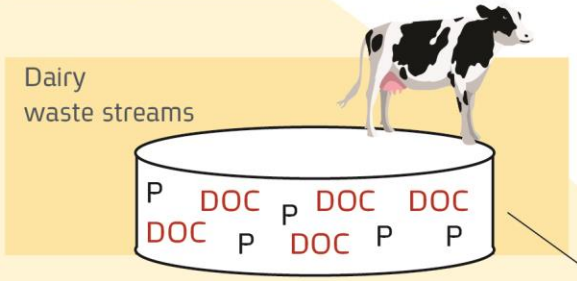


P associations and pools upon Al/O-WTRs

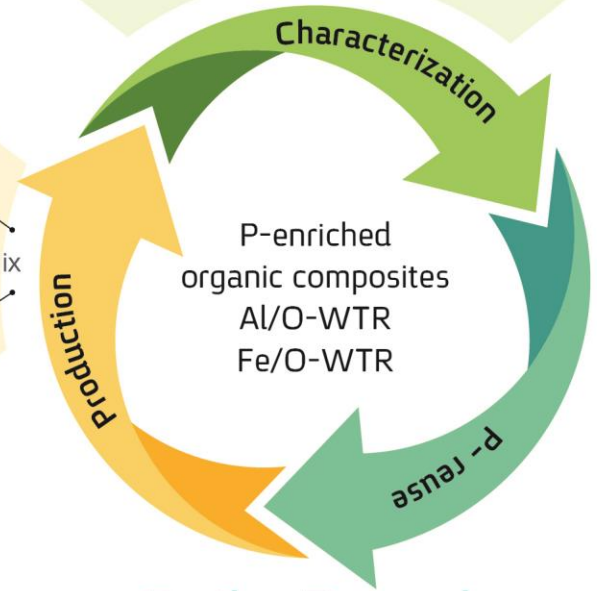


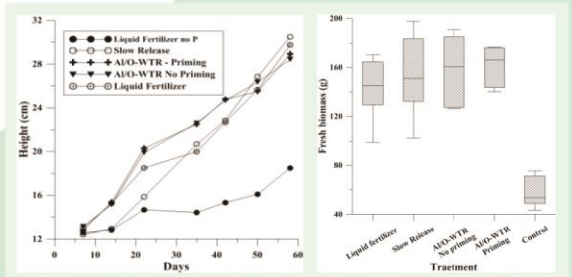


NH_4Cl ext	Labile
NH_4F ext	Al-P
NaOH ext	Fe-, OM-P
Na-acetate ext	Sorbed Ca-P
HCl ext	Detritus Ca-P
Oxalate ext	Residual P



SEM image





Al/O-WTR | Slow release | Control

Further Research

Efficient P recycling Fe bioavailability

Start: 1/1/2015
End: Open-ended

Funding: BARD agricultural research and development, Israel Ministry of Agriculture and EU CEREHA (Centre of Excellence for Research on Environment, Health and Aging)

Phosphorus efficiency in pigs & poultry: bridging the gaps in the P value chain

(September 2017 – August 2020) http://pegasus.fbn-dummerstorf.de

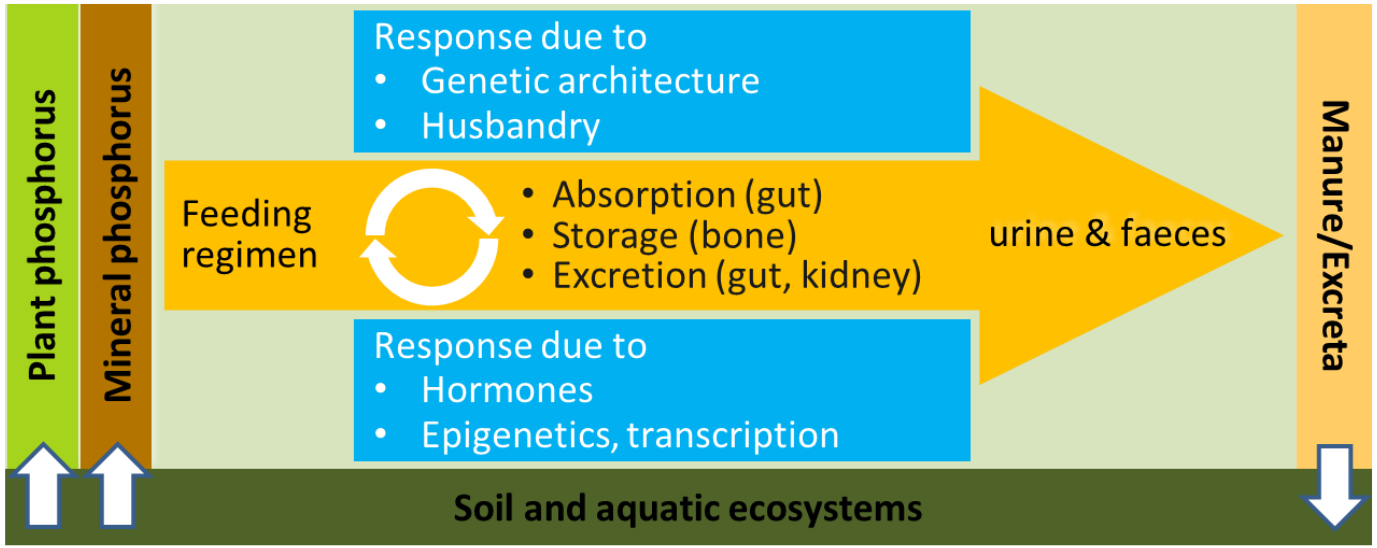
Project aims

a) Strategies to increase bioavailability, digestibility & efficiency of plant P in mono-gastric animals

b) Reduce P losses and emissions from pig & chicken husbandry

c) Technical, policy & governance strategies to minimize P runoff from soil and enrichment in aquatic ecosystems

P cycle in animal production



Research areas

a) Animal husbandry
- Feeding strategies (P-conditioning, phytase, pre-digestion)
- Alternative feed sources (e.g. comfrey, low-phytate cereals)
- Genetics and gut microbiota affecting the efficiency of P digestion
- Methods of manure handling

b) Soil systems – characterizing fodder crops & slurry/manure

c) P losses to nature and ways to reduce them

d) Reuse options – providing incentives to close the loop on P

e) Bio-economy model – looking at the economic gains and losses and environmental impact

f) Governance and policy

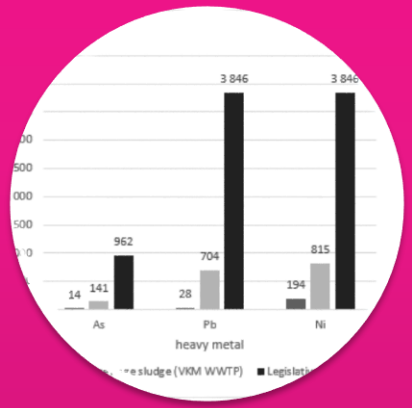
ERA-NET SUSAN

RAVITA- thinking outside the recovery box

01/2015 – 12/2019

P recovery directly from <u>wastewater</u>

Products:
H_3PO_4
&
MAP/DAP



Low concentration of MPs

Demo plant at Viikinmäki WWTP

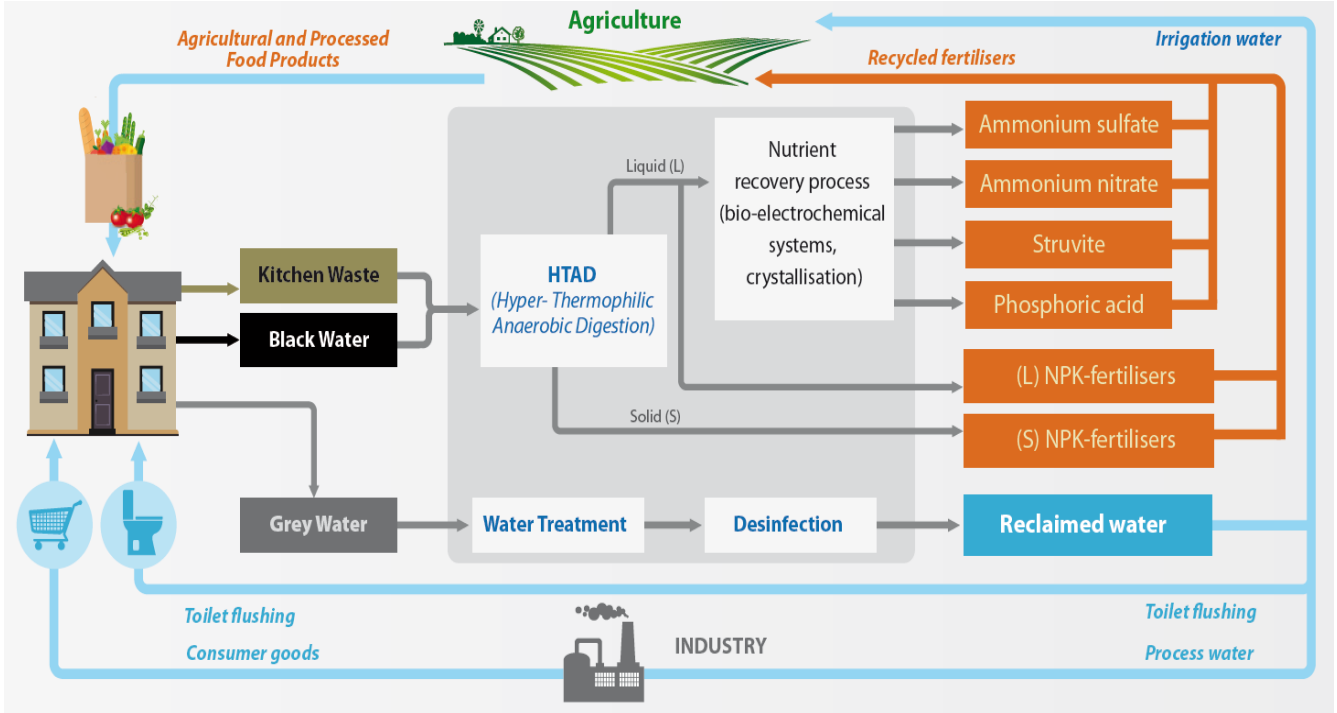
(1000 PE)

GOVERNMENT KEY PROJECT

Recovery and
Utilization of
Nutrients
4 Low Impact FErtilizer

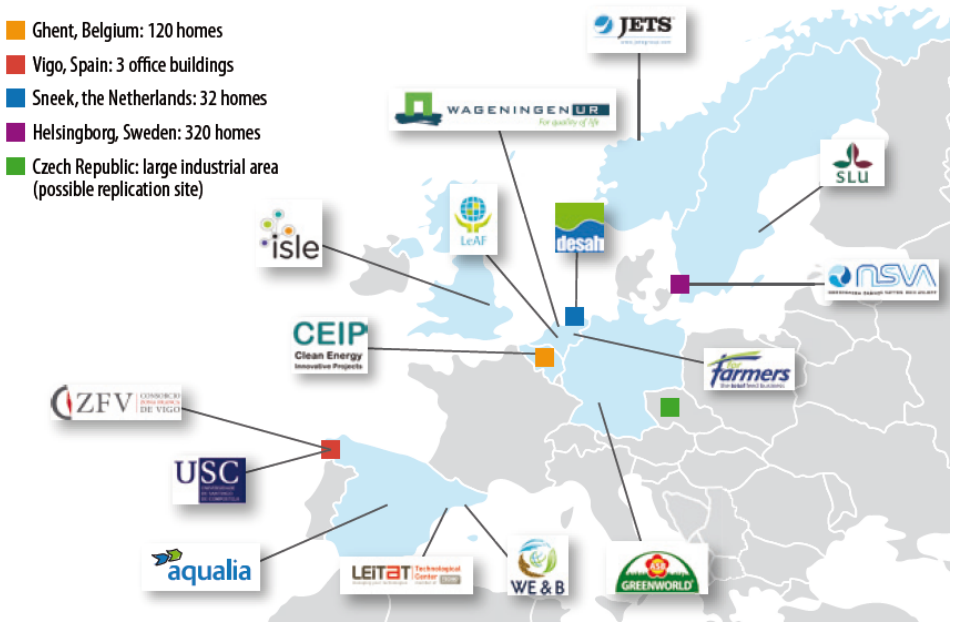
RUN4LIFE

June 2017 → May 2021



- Domestic wastewater: important **nutrient carrier** not exploited currently
- Decentralized nutrient recovery from wastewater at the **source**

- Improve innovative technologies
- Large scale demonstration of nutrients recycling
- Evaluate impacts on environment, society and economy
- Promote acceptance of recycled products
- Value chain for the recovered products

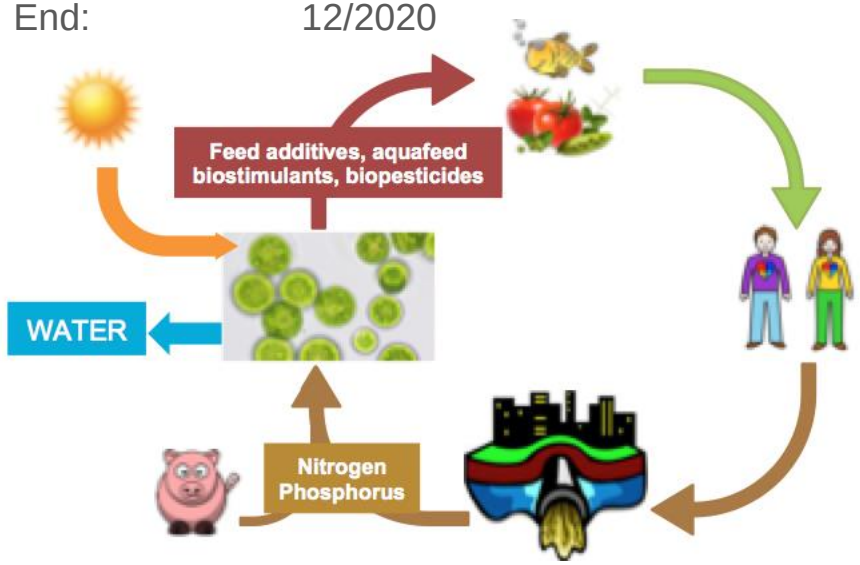


The Run4Life project receives funding from the EU Horizon 2020 Research and Innovation programme, under G.A. No 730285.

This project is funded by the European Union

SABANA : Sustainable Algae Biorefinery for Agriculture aNd Aquaculture

Start: 12/2016
End: 12/2020



Demonstrate an integrated microalgae-biorefinery to produce high-value and low-value products for agriculture and aquaculture

accomplishing market and social requirements

Objectives contributing to nutrient recycling and management :

Implement large scale microalgae production recovering nutrient from wastewater and slurry

No use of synthetic fertilizers

Recovery of nutrients contained in wastewater

Recovery of waste CO2 and minimization of greenhouse gas emissions from wastes (wastewater and flue gases)

Implementing LCA of the whole model

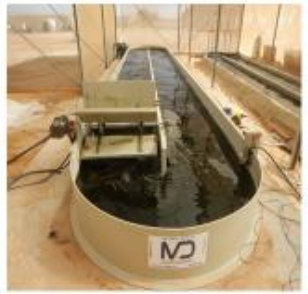
Assure economic sustainability and market penetration of final algae products

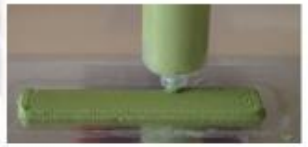
SaltGae: Algae to treat saline wastewater

SaltGae
algae to treat saline wastewater

Duration: June 2016 - May 2019
20 partners, budget 9,8 M€



Objectives and achieved results:

- techno economicaly viable solution for treatment of saline wastewater
- **3 DEMO SITES - 3 different WW**: **Slovenia** (tannery ww), **Italy** (whey WW), **Israel** (fish WW); salinity up to 100 g NaCl/L
- 2 stage AD adapted to salinity up to 50g Na+/L
- Halotolerant algal-bacterium consortium selected
- LCA, LCCA and novel HP pump
- **Valorisation of effluents:** algae based coatings, filers, animal feed, extraction of lipids

Demo sites open for visits!

H2020-Water-1b-2015

This project has received funding from the European Union's Horizon 2020 Innovation Action programme WATER under grant agreement no 689785

www.saltgae.eu

3rd European Nutrient Event, November 8th – 9th, 2018, Rimini (Italy)

SYSTEMIC

www.systemicproject.eu

Coordination: Oscar Schoumans, Wageningen Environmental Research
Email: Oscar.Schoumans@wur.nl

SYSTEMIC
Circular solutions for biowaste

Horizon 2020

Systemic large **s**cale eco-innova**t**ion to advance circular **e**conomy and **mi**neral re**c**overy from organic waste in Europe (2017 -2021)

Using existing large scale digesters plants as a technology hub for new business in recovery & recycling of energy, nutrients and soil improvers

- Advancing TRL (5 → > 7) at 5 demonstration plants (Nl, B, D, UK, It) including development of viable business cases (leading pioneers)
- Business opportunities for 10 outreach locations (first followers)
- Policy advise to overcome innovation barriers and advancing CE in the EU

BACKGROUND

Chemicals are an essential part of European Union citizens' daily lives, and the chemical sector is also a **major strategic sector for the EU**;
Chemistry is in every aspect of our life, even if often we do not see it.
But, if not properly used and controlled, some chemicals can pose a severe threat to the **environment** and **health**.

Several specific **phosphorus derivatives** are used in a wide range of applications, including pharmaceuticals, childcare products, detergents, lubricants, plastic additives and flame retardants.

STATE OF THE ART

Although there is no conclusive data on their toxicity for human health and the environment, **these chemical additives' production can involve intermediaries (such as specific ammines)** that need to be treated and recovered, or **the use of phenol**.

These intermediates are often categorized as highly dangerous. Additionally, **wastewater produced** in the process needs to be treated before disposal or recycling and by products are not fitting with the circular economy concept

LIFE-TRIALKYL

RISE Italmatch Chemicals Sviluppo chimica spa

An innovative and sustainable continuous process for the development of high quality trimethyl phosphite

LIFE14/ENV/IT/000346

Start date:16/07/2015 End date:16/07/2019

OBJECTIVES of LIFE TRIALKYL:

- Set up an innovative, highly sustainable and efficient industrial chemical process;
- Avoidance of the production of hazardous intermediaries, useless by-products and the use of dangerous chemicals for waste water treatment;
- Reduction of energy consumption in the process by 20-30%
- Reduction water consumption by up to 100%, compared to the current production process and eliminate any need of waste water treatment
- Impact on agrochemistry with regard to:
- Production of insecticides that acts as acetylcholinesterase inhibitors to control insects in a wide range of crops. This production of insecticides in EU consumes around 1500 MT/y of imported, low sustainable trialkylphosphite.
- Inclusion of NH_4Cl solid phase secondary product for agro applications fitting with Circular economy concept
- Enhancement of the multiple waters strategy by making the industrial water reusable in agriculture

Life

- Increase awareness about alternative sustainable and eco-friendly chemical processes in the chemical industry.

LIFE15 ENV/IT/000392 – LIFE VITISOM:

VITiculture Innovative Soil Organic Matter Management: variable-rate distribution system and monitoring of impacts

DURATION:

Start 01/07/2016 - **End:** 31/12/2019

Junior Researcher Federico Sambo – Università degli Studi di Milano

MAJOR PROBLEMS

1) Loss of Soil Organic Carbon → < Soil fertility
2) < Level of innovation for the distribution of organic matter in vineyard → waste of resources

OBJECTIVE 1 : Improve the quality of vineyard soils in terms of soil structure, organic matter content and biodiversity
OBJECTIVE 2 : improve the organic fertilization distribution systems using VRT

CURRENT SITUATION

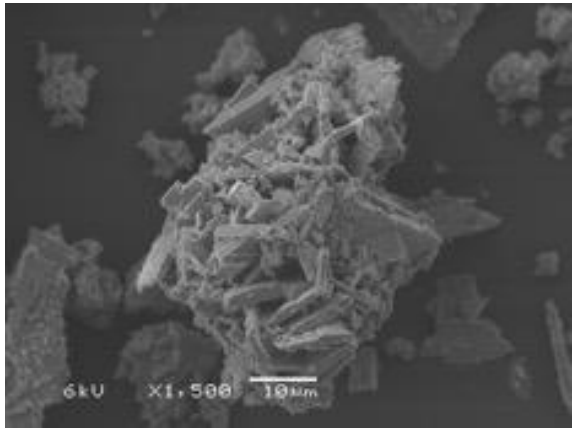
Periodic monitoring of the vigor and of the GHG emission on 12 hectares, 22.000 fluxes of CO2 recorded; 252 soils(QBS-ar) and 2.300 grapevines analyzed, 84 microvinification carried out

EXPECTED IMPACTS

Upgrade of economical and environmental efficiency of vineyard fertilization:
Reduction of chemical fertilizers, and, in organic vineyards, of organic matter distributed;
Increase the homogenization of vineyards vigor.
Validation of Soil protection system in 5 pilot contexts(representatives of EU vineyard variability):
Reduction of emissions from vineyard soils (10%), of costs (20%);
Increase of the organic matter of the soil (5%), of soil biodiversity (5%).

ViviMAG

Magnetic recovery of vivianite from iron phosphate containing sewage sludge



CONSORTIUM

wetsus

TU Delft

Outotec

kemira

Pilot host: Waterschap Brabantse Delta

PRINCIPLE

- Vivianite, $Fe(II)_3(PO4)_2$, is the main P bearing precipitate in digested, Fe containing sewage sludge
- Up to 70-90% of all P can be present as vivianite
- Commercial wet magnetic separators can recover the vivianite from the sludge in pure form

IMPACT

- Opens P recovery from wwtp's using chemical P removal
- High potential recovery efficiencies (>50%)
- 10-20% reduction of sludge volume expected
- Vivianite can used as such (paint, batteries, Fe-fertiliser) or transformed in water soluble P fertiliser and FeO for reuse of Fe

1 m^3/h pilot facility at wwtp Nieuwveer, NL

wetsus

Project period:
1/1/2018 – 1/7/2020

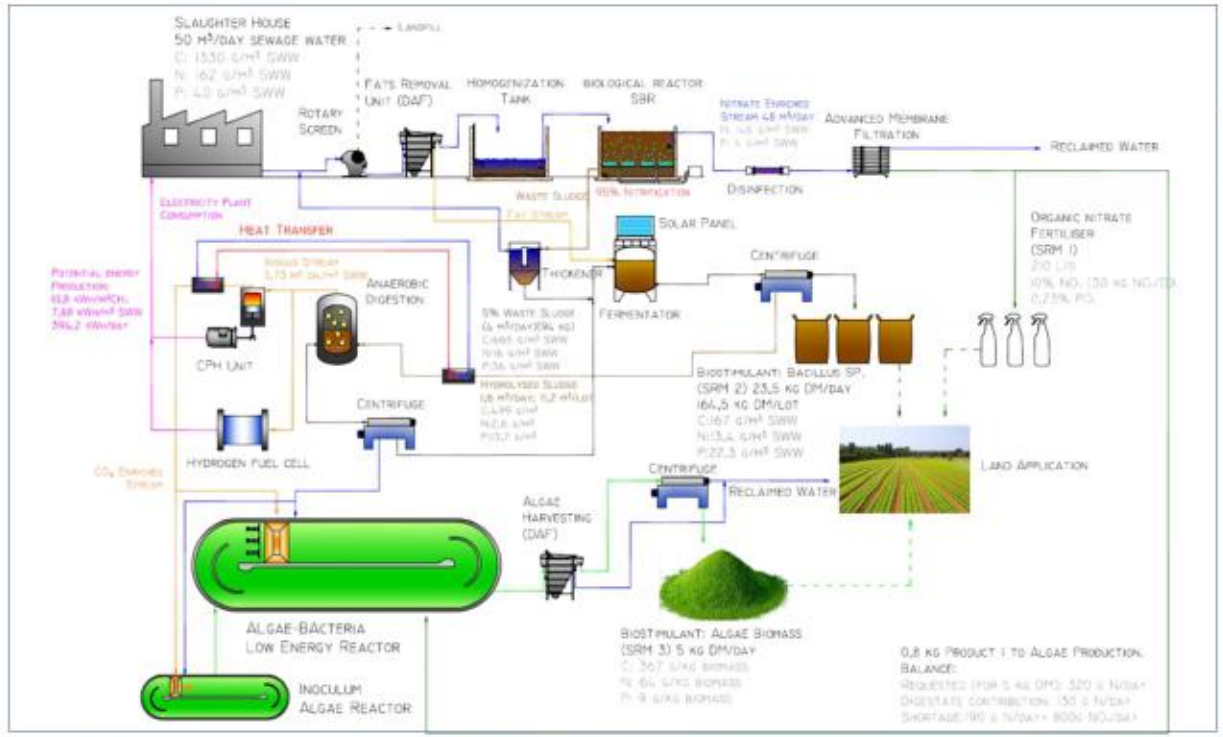
eit RawMaterials
Connecting matters

This activity has received funding from the European Institute of Innovation and Technology (EIT), a body of the European Union, under the Horizon 2020, the EU Framework Programme for Research and Innovation

REcovery and REcycling of nutrients, TURNing wasteWATER into added-value products for a circular economy in agriculture

Water2REturn

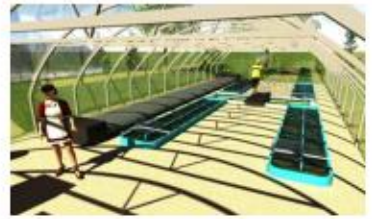
01-Jul-2017 – 31-Dec-2020, 15 partners, budget: 7.1 M€

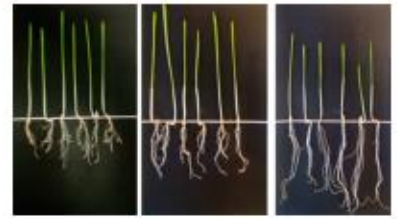


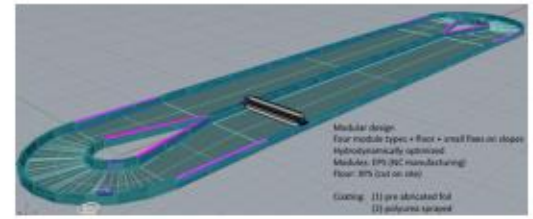
Treating **slaughterhouse WW, recovering energy** and **nutrients, fertilizers** and **biostimulants** for **agricultural use.**

- Aerobic SBR waterline with membrane separation
- Fermentation by bacilus subtilis
- UASB energy valorisation of sludge
- Nutrient recovery by algae

Demo in Seville, 50 m³ WW daily







H2020-Water-1b-2015

This project has received funding from the European Union's Horizon 2020 Innovation Action programme WATER under grant agreement no 689785

www.saltgae.eu

3rd European Nutrient Event, November 8th – 9th, 2018, Rimini (Italy)

European Sustainable Phosphorus Platform

This project has received funding from the EU Horizon 2020 research and innovation programme under grant agreement No. 690323

SMART-Plant

Italian Phosphorus Platform

15 ANNI GRUPPO HERA

ECOMONDO THE GREEN TECHNOLOGIES EXPO 22ª Fiera internazionale del recupero di materia ed energia e dello sviluppo sostenibile — Green & Circular Economy 6-9 Novembre 2018 Rimini Italy — IN CONTEMPORANEA CON KEY ENERGY

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