



# **BIOREFINE: INNOVATIVE STRATEGIES FOR THE RECYCLING OF INORGANIC CHEMICALS FROM AGRO- AND BIO-INDUSTRY WASTE STREAMS**

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**Energy & Nutrient  
Cycling for a  
Sustainable  
Economy**



Investing in Opportunities



This project has received  
European Regional  
Development Funding  
through INTERREG IV B.

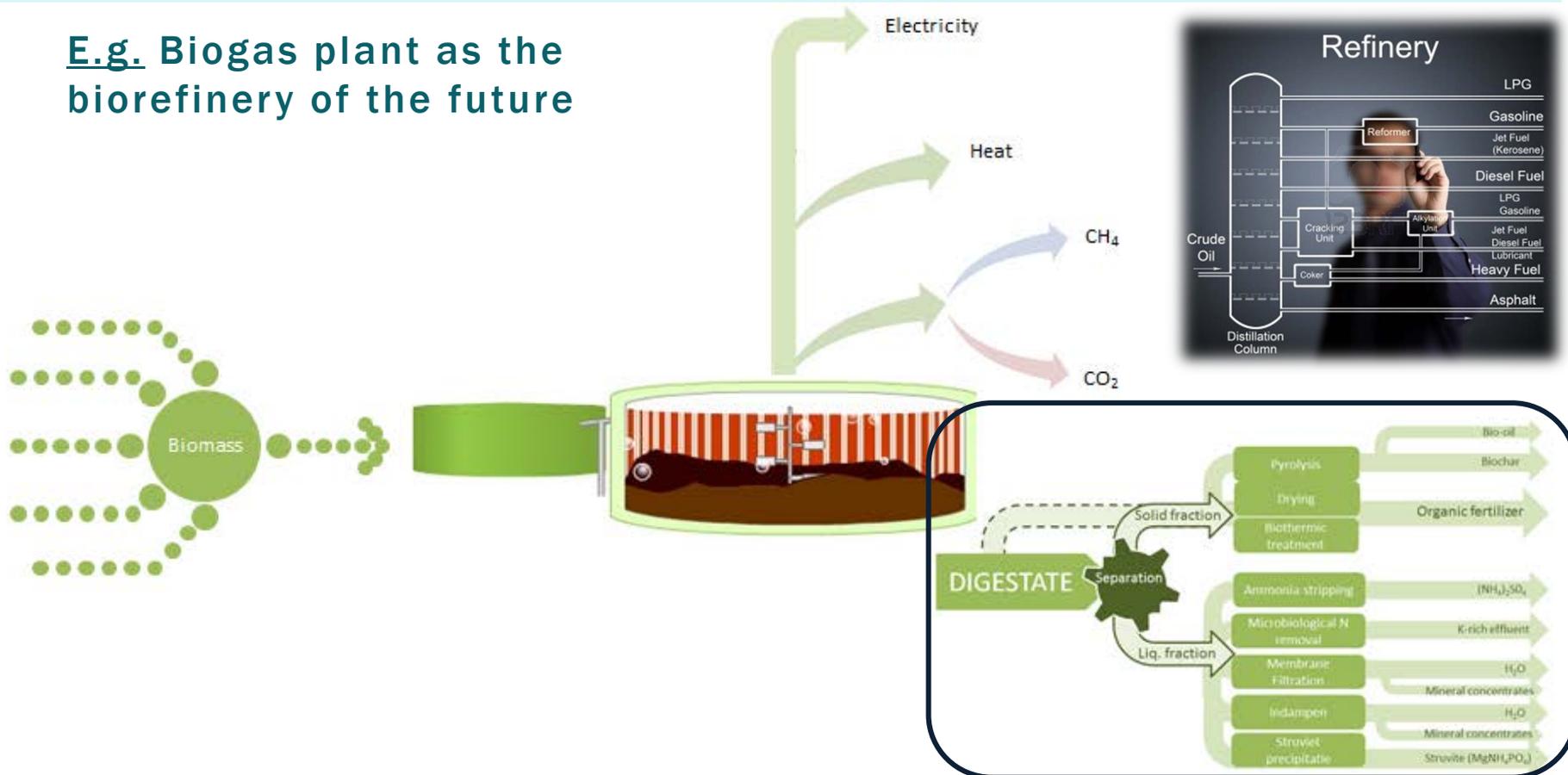


INTERREG IVB

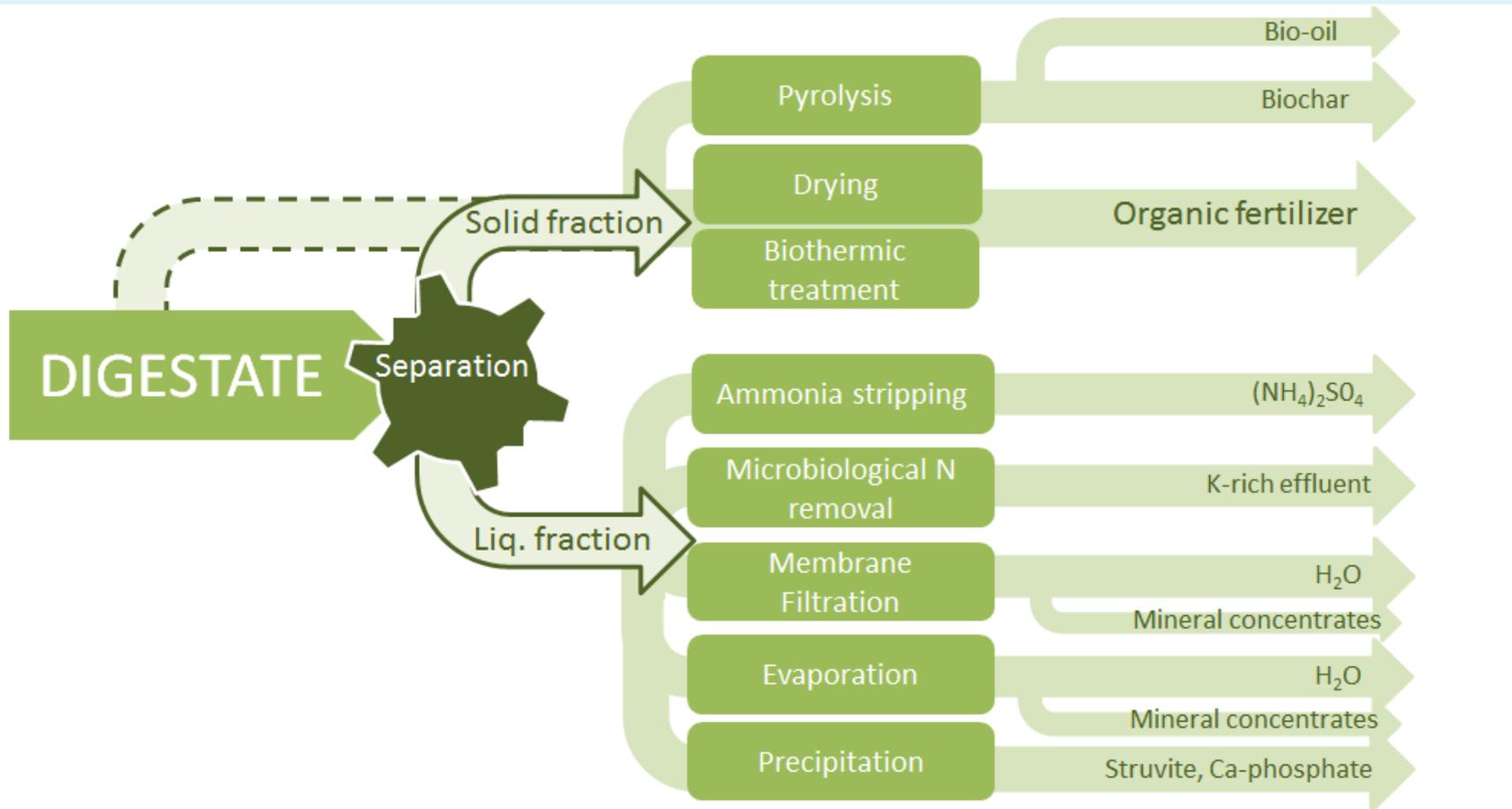
# ORIGIN

- **BIOREFINERY:** Production of energy carriers and new derivatives from renewable biobased resources

E.g. Biogas plant as the biorefinery of the future



# ORIGIN



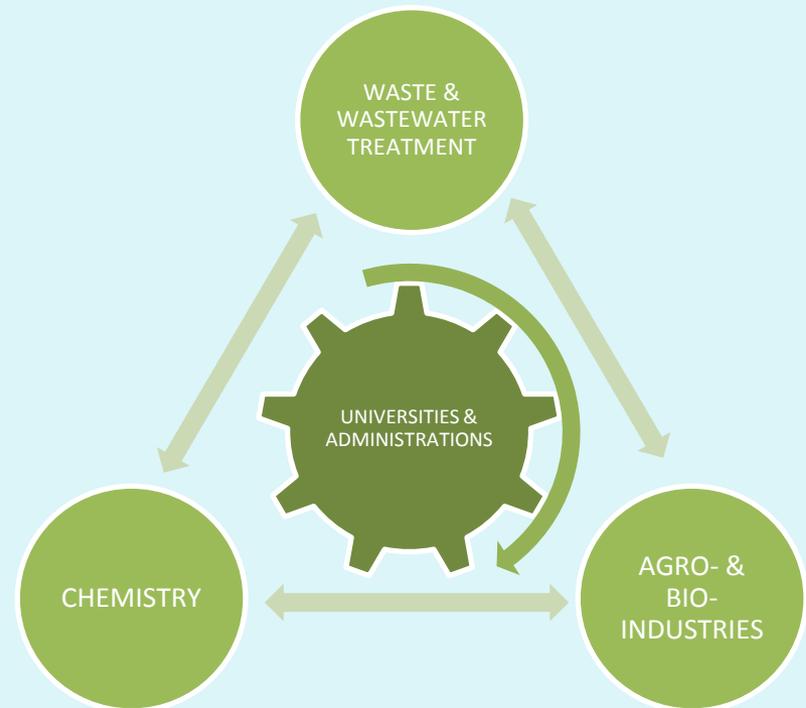
# BIOREFINE PROJECT



RECYCLING INORGANIC CHEMICALS FROM AGRO- AND BIO-INDUSTRIAL WASTE STREAMS

## AIMS:

- Support cross-sectoral and international **networking**
- Deliver **technical solutions** for recycling of minerals
- Induce change in **legislation**
- Stimulate **market creation**



# BIOREFINE PROJECT



- Recycling inorganic chemicals from agro-and bio-industrial waste streams
- Networking - technical solutions - legal advice - market creation

## WP1 Transnational collaborative and interactive platform

### WP 2

Classification matrix of nutrient sources and recovery and reuse processes



### WP3

Pilot scale explorations and demonstrations of good practice techniques

### WP4

New strategies and synergies in cross-sectoral resource recovery



### WP5

Road map to implementation of new strategies and policies

## WP1 Transnational collaborative and interactive platform

### Action 1. Establishing Regional Nutrient Platforms

Flanders  
The Netherlands  
Germany  
United Kingdom  
France

### Action 2. Establishing dialogue and cooperation between the different networks



Participate  
Collaborate  
Innovate

### Action 3. Establishing bilateral working groups

Flanders-France  
Flanders-Germany  
Flanders-Walloon Region



**Action 4.** Identifying qualitative and quantitative nutrient requirements of the market as a basis for selecting appropriate techniques

**Action 5.** Identifying nutrient recovery techniques from anaerobic digestion derivatives

**Action 6.** Identifying nutrient recovery techniques from animal manure and agr.wastes

**Action 7.** Identifying nutrient recovery techniques from industrial and domestic wastes



## WP3

Pilot scale explorations and demonstrations of good practice techniques

# Action Plan

**Action 8.** Pilot scale installation for struvite production from digestate (sludge) from a Municipal Waste Water Treatment Plant

**Action 9.** Pilot scale installation for the recuperation of nitrogen from digestate by stripping and subsequent air scrubbing

**Action 10.** Production of a nitrogen-potassium fertilizer from processed manure using reversed osmosis



# STRUVITE RECOVERY PILOT



## Pilot at Aquafin WWTP facility in Leuven

- Stripping (pH increase) and crystallization reactor (addition of  $MgCl_2$  -> struvite formation)
- Influent contains 100 ppm P
- Process efficiency > 80%
- > 15% of total P in MWWTP is recovered



## Operational benefits

- Improved dewaterability
- Lower backflow of nutrients
- Avoid struvite precipitation in pipes

## Challenges

- Improving separation of struvite crystals from sludge
- Cheap and efficient way to wash the crystals



# PLANNING

January - February 2015

## Initiation

- Site visit (mid-January)
- Gathering information
- Set-up experiments

March - June 2015

## Experiments - Assessments

- Product (struvite) characterization
- Comparison to struvite from industrial waste water
- Pot-trials (4-6 weeks) and extractions to determine P-availability
- Economic & ecologic assessment

March - December 2015

## Dissemination

- Publication of leaflet
- Publication to general public
- Contribution to book chapter on nutrient recovery cases
- Scientific publication (if feasible)
- Contribution to BioRefine Bulletin
- Study visit
- Presentation at closing event/RRB-11 (June 2015)
- ManuResource Workshop (December 2015)

# AMMONIA STRIPPING AND SCRUBBING PILOT



Stripper scrubber pilot at Waterleau New Energy plant in Ieper

- Stripper: ammonia is removed (stripped) out of the liquid fraction of digestate by blowing air through the liquid stream in a tray stripper (WATTRAY®)
- Scrubber: the stripping gas charged with ammonia is put into contact with a sulfuric acid solution in a packed scrubber (WATPACK®), resulting in ammonium sulfate, which can be used as an N-S-fertiliser
- Batch and semi continuous mode
- Varying initial concentrations: 0.8 – 4.0 g NH<sub>3</sub>/L
- Performed experiments
  - T optimization
  - pH optimization

	Stripper	Scrubber
Flow	1500 L/h	5.5 m <sup>3</sup> /h
T	50 - 60°C	N/A
pH	9 - 10	3 - 5

# PLANNING

January - February 2015

March - June 2015

March - December 2015

## Initiation

- Site visit (16 January)
- Set-up working plan

## Experiments - Assessments

- Pilot validation
- Product (ammonium sulfate) characterization
- Additional experiments t.b.d.
- Economic & ecologic assessment
- Study visit

## Dissemination

- Publication of leaflet
- Publication to general public
- Scientific publication (if feasible)
- Contribution to BioRefine Bulletin
- Presentation at closing event/RRB-11 (June 2015)
- ManuResource Workshop (December 2015)

## WP4

New strategies and synergies in cross-sectoral resource recovery

# Action Plan

Action 11. Nitrogen recovery from liquid fraction of animal manure



Action 12. Phosphorus recovery from animal manure



Action 13. Hydrothermal processing routes for recovery of nutrients



Action 14. Use of algae for nutrient recovery



Action 15. Use of ashes coming from heating plants



## WP5

### Road Map to Implementation of New Strategies & Policies

**Action 16.** Examine logistics – identify spatial demand for nutrients relative to source of recovered nutrients



**Action 17.** Identify life-cycle costs from whole-of-society perspective (including economic, social, environmental)

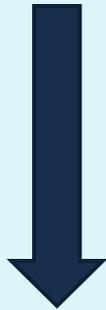
**Action 18.** Identify any synergies & conflicts with other services (sanitation, energy, food)

**Action 19.** Identify and addressing limitations and constraints in national, regional and European legislative frameworks

**Action 20.** Identify most appropriate policy instruments (e.g. regulatory, economic, communicative) to facilitate the chosen nutrient recovery and reuse options



# CLUSTER LAUNCH



**INTERREG IVB NWE BIOREFINE**  
as launching platform  
for Biorefine Cluster Europe



# CALL FOR ABSTRACTS RRB-11 (YORK, UK)



UNIVERSITY *of York*

**Sessions on nutrient cycling**

**11<sup>th</sup> Conference on Renewable Resources  
and Biorefineries (RRB-11).  
June 3-5, 2015, York, United Kingdom.  
<http://www.rrbconference.com/>**

# CONTACT

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