

## Netherlands

### Farm's performance, restructuring & modernisation

#### Location

Zuidoost-Noord-Brabant

#### Programming period

2014 – 2020

#### Priority

P2 - Competitiveness

#### Measure

M16 - Cooperation

#### Funding

Total budget 691 420 (EUR)

EAFRD 345 710 (EUR)

National/Regional 345 710 (EUR)

#### Project duration

2017 – 2022

#### Project promoter

Eindhoven University of  
Technology

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<https://vitalfluid.com/>

**An EIP Operational Group worked on upscaling the production of Plasma Activated Water (PAW) and on demonstrating its effectiveness and cost efficiency as a sustainable nitrogen fertiliser.**

### Summary

An EIP AGRI Operational Group worked on upscaling and demonstrating the fertilising and hygienic properties of Plasma Activated Water (PAW) in the cultivation of various crops on a real-world scale. The hygienic effect of PAW was also tested on the cultivation of roses to prevent and treat the formation of mildew, demonstrating that fewer chemical pesticides are needed to improve plant health.



### Project Results

It was demonstrated that nitrogen fertiliser can be produced with the PAW technology in a decentralised way, 'in-situ' with on-farm inputs, and without any CO2 emissions.

Making the PAW technology widely accessible to farmers will make farm businesses less dependent on the current fertiliser supply chain and contribute to reducing the use of fertilisers made using fossil fuels. The Operational Group results will also showcase the positive effects of using PAW as a spray on plant health to reduce the use of pesticides.

### Lessons & Recommendations

- ❑ The fact that PAW can reduce the need for pesticides and improve plant health is an exciting prospect at a time when fewer resources are available to farmers to protect their crops and the need to reduce CO2 emissions imperative.
- ❑ Innovation is therefore shown again to play a key role in providing sustainable alternatives for agriculture.

## Context

In total the supply chain of synthetic nitrogen fertilizer is responsible for 5% of the world's greenhouse gas emissions. Synthetic chemical pesticides end up in our environment and stay in our water and soil for decades. Exposure to pesticides poses a serious and continuous health hazard, especially in the agricultural working environment.

Plasma Activated Water (PAW) is a sustainable nitrogen fertilizer, and an environmentally friendly alternative to chemical pesticides. Activating water with plasma only requires water, air, and electricity, into which reactive oxygen and nitrogen are added, thereby producing nitrogen fertiliser without fossil fuels, and making the process CO<sub>2</sub> neutral. 70% of traditional fertiliser is leached into the environment and only 30% absorbed by the crops. PAW-based precision fertiliser application can significantly reduce this leaching. The PAW also acquires temporary hygienic properties, that, when sprayed on crops, improves plant health, reducing the need for chemical pesticides.

## Objectives

The aim of this EIP AGRI Operational Group was to scale-up this plasma technology so that PAW could be used and demonstrated on a large scale in greenhouse and vertical farm cultivation. The Operational Group also aimed to test the economic efficiency of the PAW technology and its effectiveness on the crops compared to fossil fuel-based fertilisers.

## Activities

The Operational Group consists of universities (technical and agricultural), high-tech companies, agricultural research companies, farmers, growers, and end-users.

The plasma technology was upscaled to a 15-kW machine that produces 13.5 mol of nitrogen fertilizer per hour. These machines were used for the demonstration tests and were a sound basis upon which to develop the technology for commercial systems.

The technology was tested on greenhouse and vertical farm cultivation of tomatoes, cucumbers, and lettuce.

The industrialization and manufacturing of PAW-based fertiliser units has been achieved through collaboration between the company VitalFluid and the VDL Group, with the latter overseeing commercial production.

The hygienic effect of PAW was tested on the cultivation of roses to prevent and treat the formation of mildew. The tests demonstrated that fewer chemical pesticides were needed to improve plant health when spraying PAW at the same time as feeding the crop with its only residue, nitrate. Other combinations of crops, seeds and pathogens are under investigation and will be researched further in 2022 and 2023.

## Main results

The EIP Operational Group demonstrated that nitrogen fertiliser can be produced with the PAW technology in a decentralised way, 'in-situ' with on-farm inputs, and without any CO<sub>2</sub> emissions.

Making the PAW technology widely accessible to farmers will make farm businesses less dependent on the current fertiliser supply chain that is dominated by big chemical companies.

This EIP Operational Group will contribute to making sustainable nitrogen fertiliser available to farmers without the use of fossil fuels in their production.

In addition, the Operation Group will demonstrate that PAW can be used in large scale crop production with the same results as synthetic fertilisers. The Operational Group results will also showcase the positive effects of using PAW as a spray on plant health and to reduce the use of pesticides.

## Key lessons

PAW technology has the potential to significantly reduce the application of synthetic nitrogen fertiliser. The fact that PAW can reduce the need for pesticides and improve plant health is an exciting prospect at a time when fewer resources are available to farmers to protect their crops and the need to reduce CO<sub>2</sub> emissions imperative.

Innovation is therefore shown again to play a key role in providing sustainable alternatives for agriculture.

*"A sustainable society is an electrical society. Electrification of fertilizer production by plasma technology is key to abate climate change and to enable safe and sustainable food production."*

A.J.M. Pemen, Inaugural Lecture at Eindhoven University of Technology

## Additional Information

<https://www.youtube.com/watch?v=VBPZihkyw4>



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