



# NoAW project

*Innovative approaches to turn agricultural waste into ecological and economic assets*

Horizon 2020 project : **2016-2020**

Coordinator: **Prof Nathalie GONTARD** (INRA Research Director) -  
*Nathalie.Gontard@univ-montp2.fr*



The project leading to this application has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 688338.

# What NoAW will offer ?



NoAW aims to pave the way for **a sustainable agro-waste bio-refinery concept** by shifting from an a-posteriori environmental assessment to **an early eco-design approach**.

NoAW targets to unlock the **potential of agro-waste to be converted into a portfolio of eco-efficient products**: **bio-energy, bio-fertilizers, bio-packaging** and **bio-molecules**, in symbiosis with urban waste conversion.



The project leading to this application has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 688338.

# Concept of NoAW:



The concept of the NoAW consists in involving all agriculture chain actors at the territory level in order to:

- **Develop innovative eco-design and assessment tools of circular agro-waste management** strategies and address related gap of dialogue, knowledge and data;
- **Improve agro-waste resources use efficiency** by upgrading the most widespread mature technology and by eco-designing **innovative bio-processes and products**;
- Ensure and accelerate the **development of new business concepts and stakeholders** platform for **cross-chain valorisation of agro-waste** on a territorial and seasonal basis.



The project leading to this application has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 688338.

# Major challenges:



NoAW will take up in a coherent manner, the five following major challenges for **ensuring sustainable agro-wastes uses**:

1. Inappropriate materials and knowledge flows management resulting in unbalanced nutrients distributions, contaminants accumulation and agro-waste conversion issues;

✓ NoAW solution: **territorial “cyclifiers”** i.e. stakeholders and materials streams connectors

2. Lack of adequate and early prediction of environmental and economic consequences of agro-waste management strategy and clear guidance to end-users;

✓ NoAW solution: **eco-design approach and multi-criteria decision tools**



# Major challenges:



3. Weaknesses of existing technologies for converting agro-wastes into biogas and bio-fertilizer;

- ✓ NoAW solution: **innovative eco-efficient AD technologies**

4. Bottlenecks for innovative building blocks, molecules and materials issued from agro-waste;

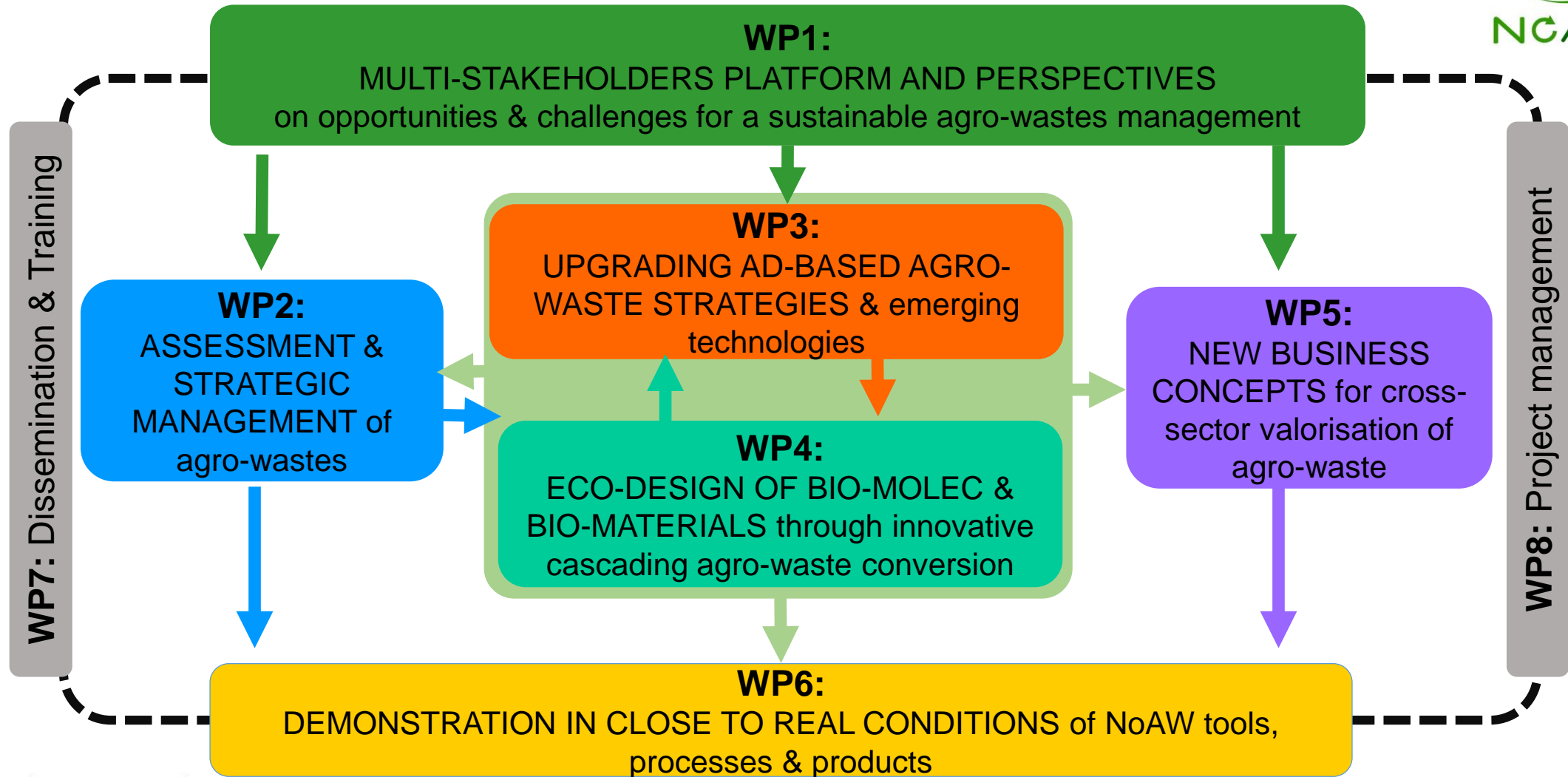
- ✓ NoAW solution: **breakthrough technology** on agro-waste conversion and bio-refinery concept

5. Lack of integration of agro-waste business in a circular economy concept;

- ✓ NoAW solution: a cross sectorial vision to bridge the gap between agro-waste science and business opportunity in order to **promote agro-waste industrial ecology concept**



# Structure of NoAW:



The project leading to this application has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 688338.

# WP1: Multi-stakeholders platform and perspectives & challenges for a sustainable agro-wastes management



- **Objectives:**

- Establishment the Knowledge Exchange Stakeholder Platform (KESP)
- Create opportunity to build and share resources, data, experiences, knowledge, skills and ideas

- **Achievements:**

- **KESP platform established**, has already 29 members
- **Tools for data management** are operational
- Method for **analysing waste and losses of agro food supply chains** was developed.
- Surveys to **analyse stakeholders perception and opinion** were carried out.
- **GIS** (Geographic Information system) **application is operational** and is being applied in the case study work of the technical work-packages
- **Key indicators and methodologies** for assessing the impact of waste management was identified and will be the basis of further work



The project leading to this application has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 688338.

# WP2: ASSESSMENT & STRATEGIC MANAGEMENT of agro-wastes

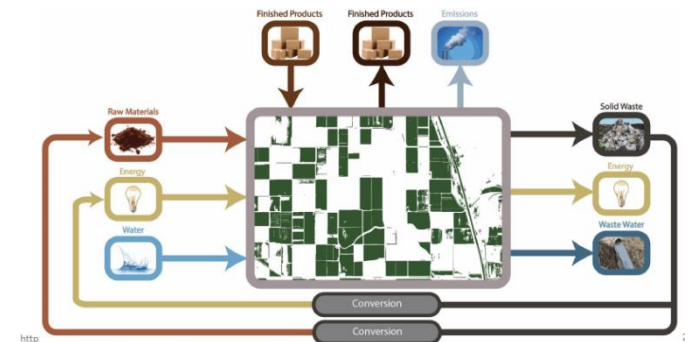


- **Objectives in first period**

- Develop decision support to guide technology development and
- Choose the best strategy for valorisation of agro-industrial wastes

- **Achievements**

- Methodologies to be used in decision support including **system boundaries and attributes** were defined and adapted
- **Hybrid TM-LCA** methodology established
- Methodology for **MCE** of planned activities is defined
- **Approach established for LCA** at early development stages





# WP3: UPGRADING AD-BASED agro-waste strategies & emerging technologies



- **Objectives in first period:**

- Optimised use of nutrients in anaerobic digestate from agro-waste
- Improve biogas technologies: enlarge possible feedstocks for biohythane production, biogas upgrade, sustainable PHA production

- **Achievements:**

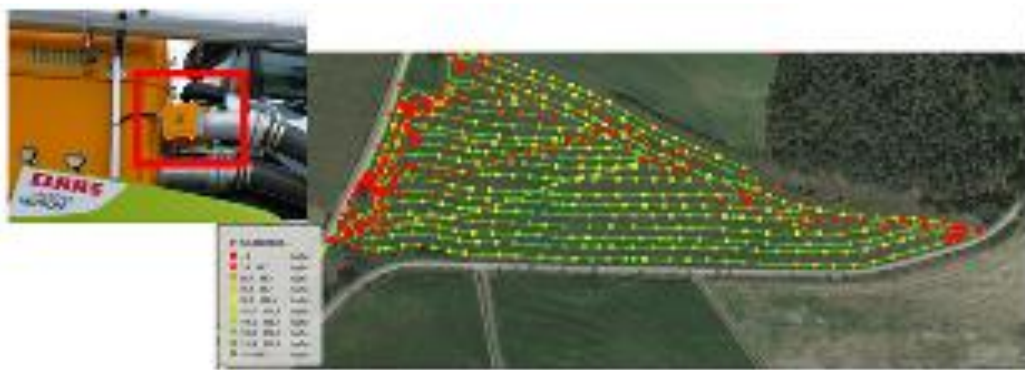
- **Nutrient studies** on field showed that NIR application helps the better use of nutrients for AD digestate
- **Pilot plants** were established:
  - for innovative technology → for producing Hydrogen, biogas, PHA and bio-methane in the same plant
  - for enlargement of platform of feedstocks by using pre-, post treated ligno-cellulosic biomass



# WP3: UPGRADING AD-BASED agro-waste strategies & emerging technologies



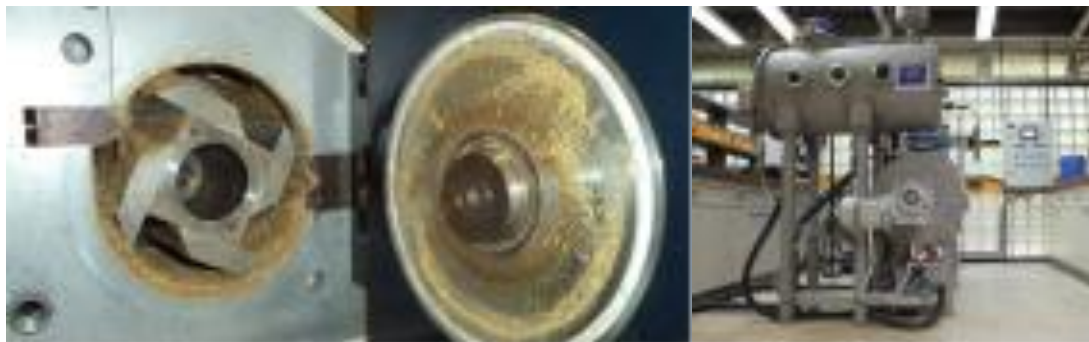
Nutrient studies



Pilot plant -hydrogen, biogas, biomethan & PHA production



Pilot plant –for pre- & post treatment of feedstock



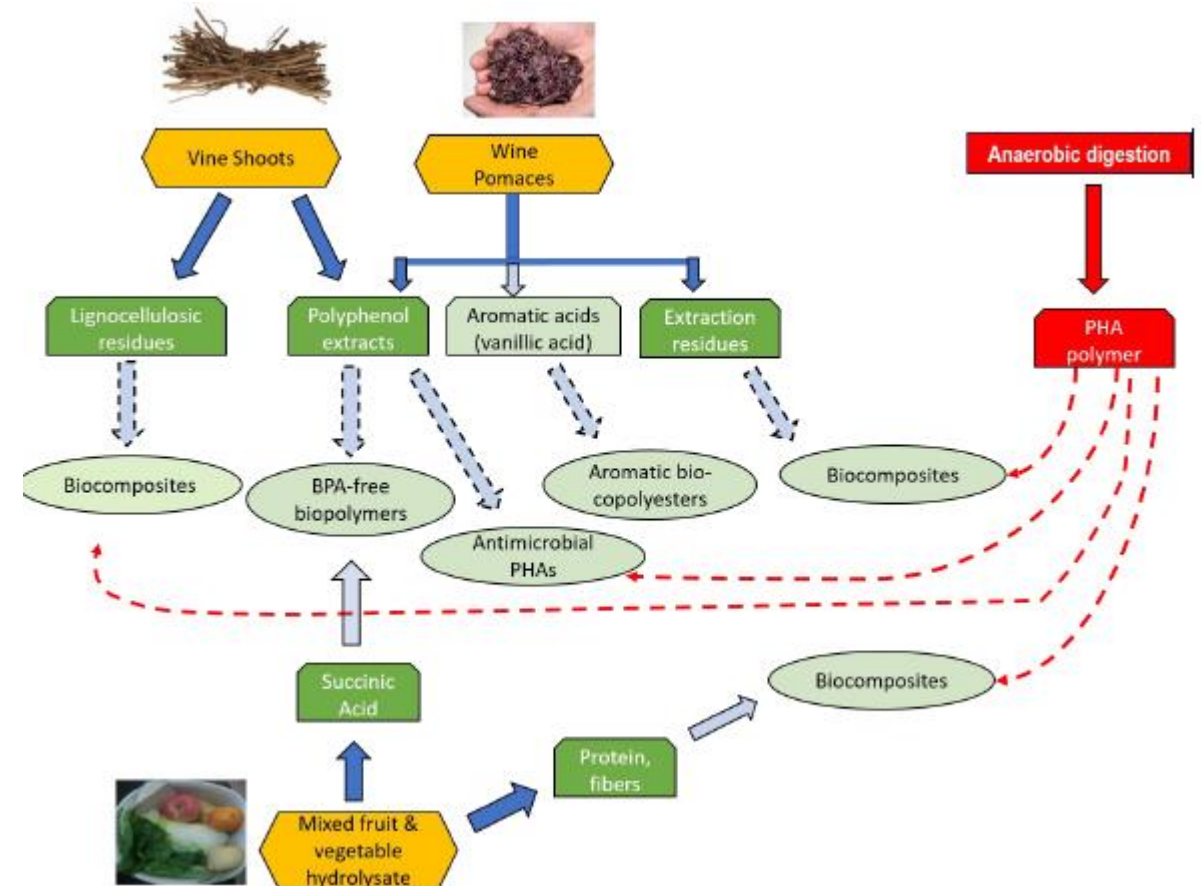
The project leading to this application has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 688338.

# WP4: ECO-DESIGN OF BIO-MOLEC & BIO-MATERIALS through innovative cascading agro-waste conversion



## • Objectives in first period:

- To develop cascading activities to convert agro-wastes and AD by products into biomolecules, chemicals, building block
- Develop high value added final products in order to substitute non-renewal equivalents



# WP4: ECO-DESIGN OF BIO-MOLEC & BIO-MATERIALS through innovative cascading agro-waste conversion



## • Achievements

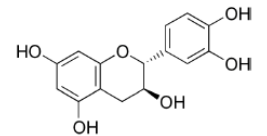
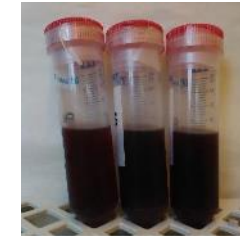
### • Valorisation of vine shoots

- Depolymerization of condensed tannins to prepare new building blocks as alternatives of petro-derived chemicals (e.g: bisphenol A)
- Preparation of PHA & cellulose based bio-composites



### • Wine pomace

- Polyphenol extraction for different procedure (valorising its antibacterial, antioxidants effects)



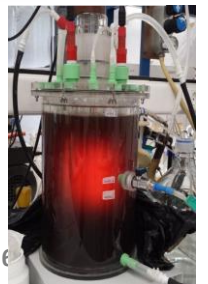
### • Vegetable waste

- Production of succinic acid, a building block of biodegradable plastic



### • Volatile Fatty Acids

- Three-fold concentration by membrane based technology
- Production of PHA from VFA using photosynthetic organism



# WP5: NEW BUSINESS CONCEPTS for cross-sector valorisation of agro-waste



- **Objectives in first period:**
  - Understanding existing business models and key success and failures factors for cross sector valorisation of waste streams
- **Achievements:**
  - **Inventory of existing clusters** and waste valorisation initiatives (worldwide): 33 initiatives analysed
    - Long-list of success and failure factors (situation related)
  - Preparing **market/business analysis** of NoAW cases
    - Inventory of initiatives + status + prices (intended products WP3)
    - Preparation of tools + data for cost-benefit analysis

Example case: AgroEnergie Hohenlohe, Germany, Centered around methanisation

Agro Energie Hohenlohe GmbH & Co. KG / Kupperzell, Germany / Initiative centered around methanisation / ongoing / Non clustered - 1 company involved - 100 Ha / job creation: 2  
FARM and INNOVATION AT METHANISATION LEVEL

**Key triggers of the initiative at the origin:** Limitations to expand the farm because of nutrient application from pig slurry on land

**Key objectives of the initiative at the origin:** Additional income generation for the farm through renewable energy production, Nutrient recovery and export to other regions / sectors

**Key historical milestones between origin and today:** 2001 start of biogas plant (55 kWel), 2003 expansion (300 kWel), 2007 fertilizer production and marketing (nutrient export), 2009 heat supply to district heating grid, 2013 virtual power supply to electric carsharing initiative

ORIGINATION

Factsheets are disseminated via the KESP platform



The project leading to this application has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 688338.

# WP6: DEMONSTRATION IN CLOSE TO REAL CONDITIONS of NoAW tools, processes & products



- **Objectives:**
  - Technological validation of one selected conversion chain and platform developed in WP3 and WP4
- WP6 starts in Month24 -> experimental work has not started
  - Task Advisory function of WP6 members in other WPs regarding up-scaleability
  - Leading the discussions into a direction to enable further industrial implementation



# WP7: Dissemination & Training



## • Objectives:

- ensure that the results of the project are communicated to the main stakeholders, through appropriate methods and format for them
- which enable the effective use of the new knowledge.

## • Achievements:

- project website with two different levels of access was developed
- activities such as papers, workshops, NoAW research summary sheets etc. also contributed to create awareness of the project and reached more than 13 000 stakeholders
- Twitter, and LinkedIn pages ensure social media coverage, will reach different target audiences.
- group young NoAW researchers is established (25 members)



Moreover, the process is very convenient to set up, as it requires no extraordinary technology. Briefly, an acidic alcoholic solution containing the xylans is poured directly on the plant raw material or in a beaker stirred during 2 h at 50°C in a stirred reactor. Then, the xylans containing the depolymerized tannins is neutralized with sodium bicarbonate, filtered and the solvents are evaporated. The methanol/xylene mix can be recycled thanks to the low boiling point of these compounds (around 35°C for both). The depolymerized tannins undergo liquid-liquid extraction with water and other acetone. The final product is a brown powder containing the depolymerized condensed tannins and other polyphenols.



### Breakthroughs, benefits and added value

The depolymerized condensed tannins obtained with this process contain mainly *o*-xylans, which is a completely original compound, specific to this reaction. Its reactivity originates from tannate, while the xylans reactivity is originally issued / xylane and other pentoses). Hence, this novel polyphenolic builder

For the first time, a condensed tannin depolymerization product / support both acidic and alkaline conditions, offering a 'x' possibilities to confer new functionalities. All previous der provide products stable enough to consider applications'

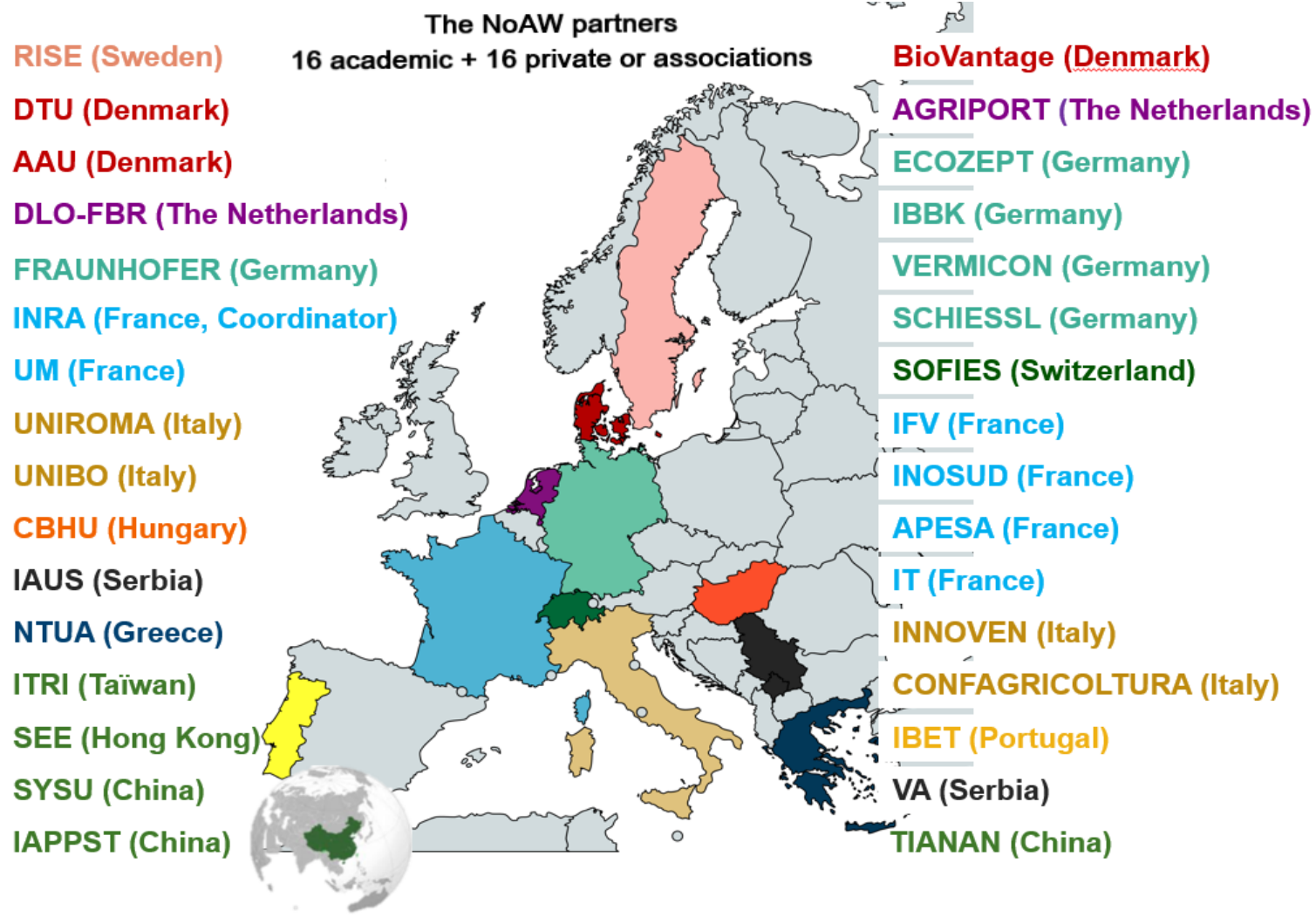
Using condensed tannin derivatives to replace herb / process and considering the tanninase tannate / epigallocatechin gallate in fully biobased and easy / towards decreasing our dependency from /

Further information on NoAW project / INRA (Coordinator): Prof. Nathalie Goussot



The project leading to this application has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement

# NoAW project partners



The project leading to this application has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 688338.





Thank you for your attention

Coordinator: **Nathalie GONTARD** (INRA) - *Nathalie.Gontard@univ-montp2.fr*



The project leading to this application has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 688338.