AGROCYCLE

for a circular economy

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The AgroCycle Project

- Led by the School of Biosystems & Food Engineering, University College Dublin
- EC funded H2020 in collaboration with the Government of the People's Republic of China and the Hong Kong Government
- 3 year project, 26 partners: EU, China, Hong Kong
- €7 million from EC plus ca. €1 million from Government of the People's Republic of China and the Hong Kong Government and direct resources inputs from the Chinese and HK partners (CAU, NJIT; and RESET Carbon from HK)

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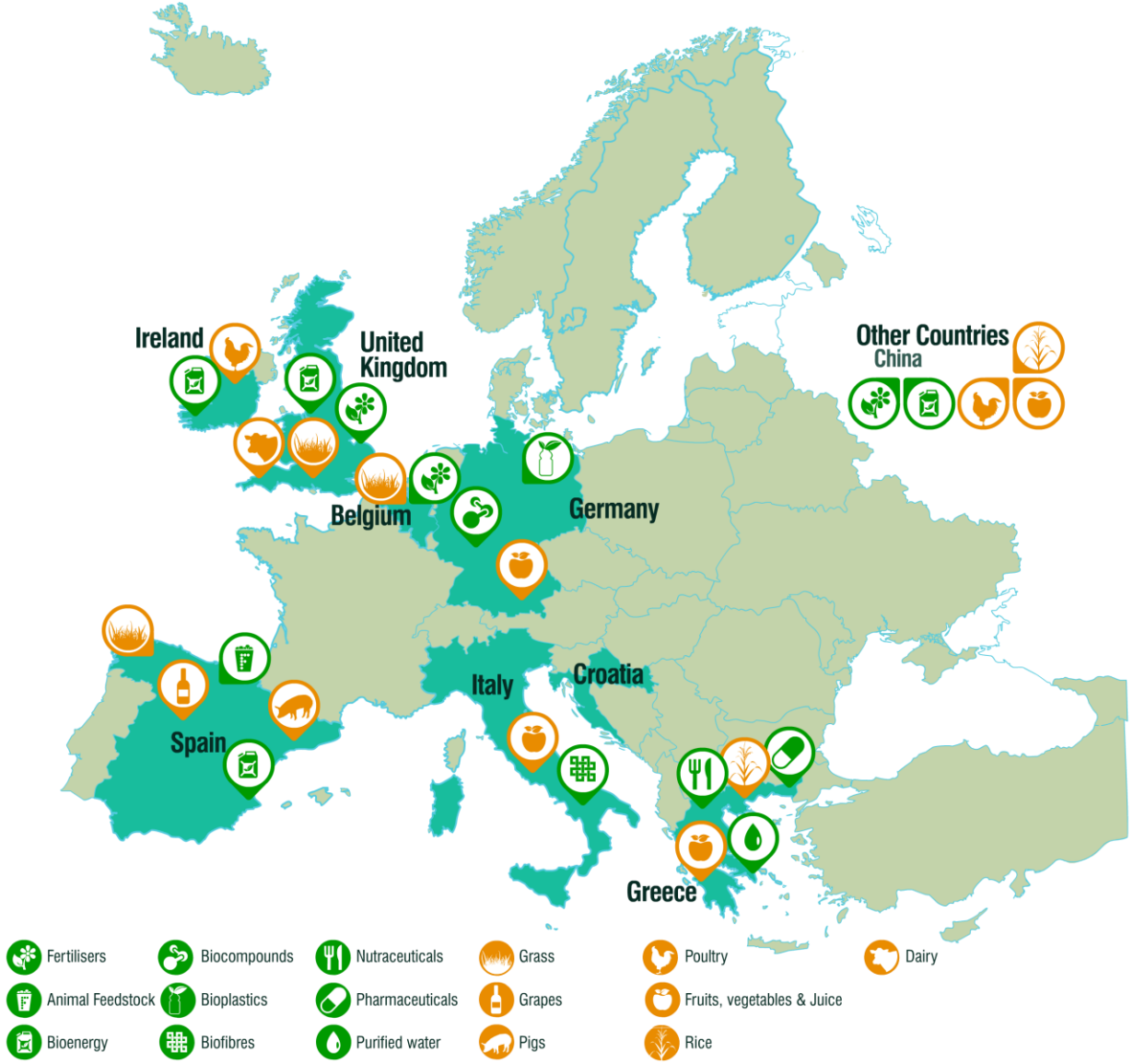
- **8 EU Countries**
  - Ireland
  - Spain
  - United Kingdom
  - Germany
  - Belgium
  - Italy
  - Greece
  - Croatia



- 23 EU partners, **2 from Mainland China** and 1 from Hong Kong

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The Project Partners


Agrii
EKO KVARNER
UCD DUBLIN
UNITING BEET GROWERS
CBE since 1927
IPCF
Consiglio Nazionale delle Ricerche
RESET Carbon
MANOR FARM IRISH CHICKEN
crea
Consiglio per la ricerca in agricoltura e l'analisi dell'economia agraria
NANJING TECH UNIVERSITY
axeb BIOTECH
exergy
iris advanced engineering
CHINA AGRICULTURAL UNIVERSITY 1905
CERTH
CENTRE FOR RESEARCH & TECHNOLOGY HELLAS
CPERI
Chemical Process and Energy Resources Institute
EUBIA
Fraunhofer IVV
UNIVERSITEIT GENT
Maynooth University
National University of Ireland Maynooth
sdewes
CEMA
European Agricultural Machinery
Harper Adams University
The Bioeconomy Consultants
NNFCC
INNOVATION for AGRICULTURE
INSTITUTO TECNOLÓGICO AGRARIO
Junta de Castilla y León
Consejería de Agricultura y Ganadería
HELLENIC AGRICULTURAL ORGANIZATION-"DEMETER"

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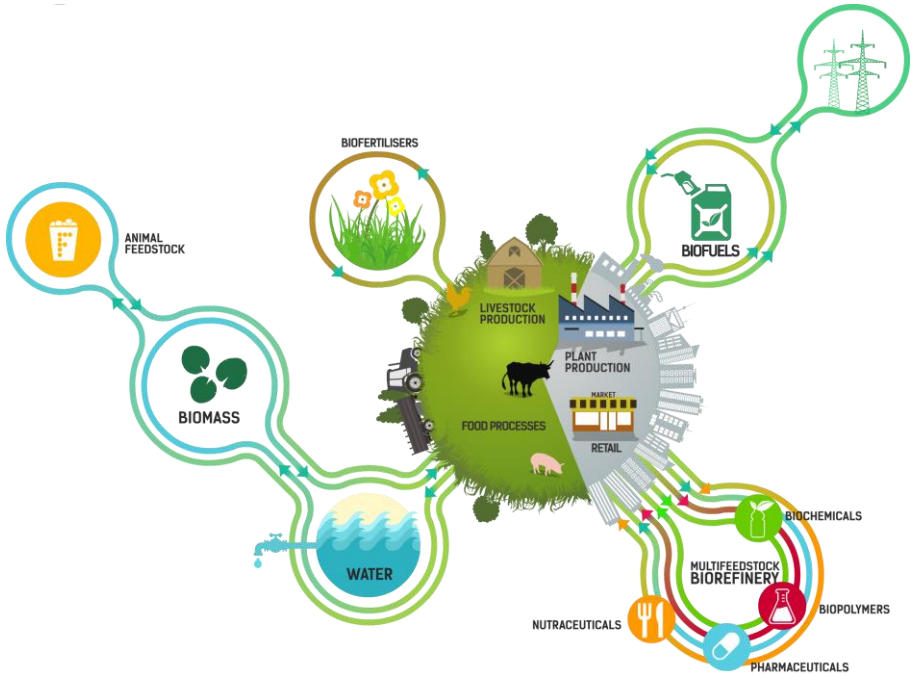
AgroCycle Objective

- To deliver sustainable waste valorisation
- Address European policy target of reducing food waste
  - 50% by 2030
- Contribute to the change occurring in China in relation to sustainability



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AgroCycle Approach

- A full systems approach
- Developing a ‘Circular Economy’ around the agri-food chain:
  - Pre- and post-farm gate
  - Food and agri-products processing sector
  - Wholesale and retail
  - Waste processing – valorisation incl. bio-fuels, high value-added biopolymers, energy & micro fuel cells.
  - Consumer

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Work Plan

Project Work Packages

- Agricultural waste value chain assessment
- Biofuels production
- Fertiliser production
- Agricultural wastewater exploitation & treatment
- Biowaste valorisation into high value products
- Life Cycle Assessment and Life Cycle Costing
- Knowledge platform and training
- Sustainable value chains and business models
- Innovation impacts

Agro-Biomass Feedstock Characterization

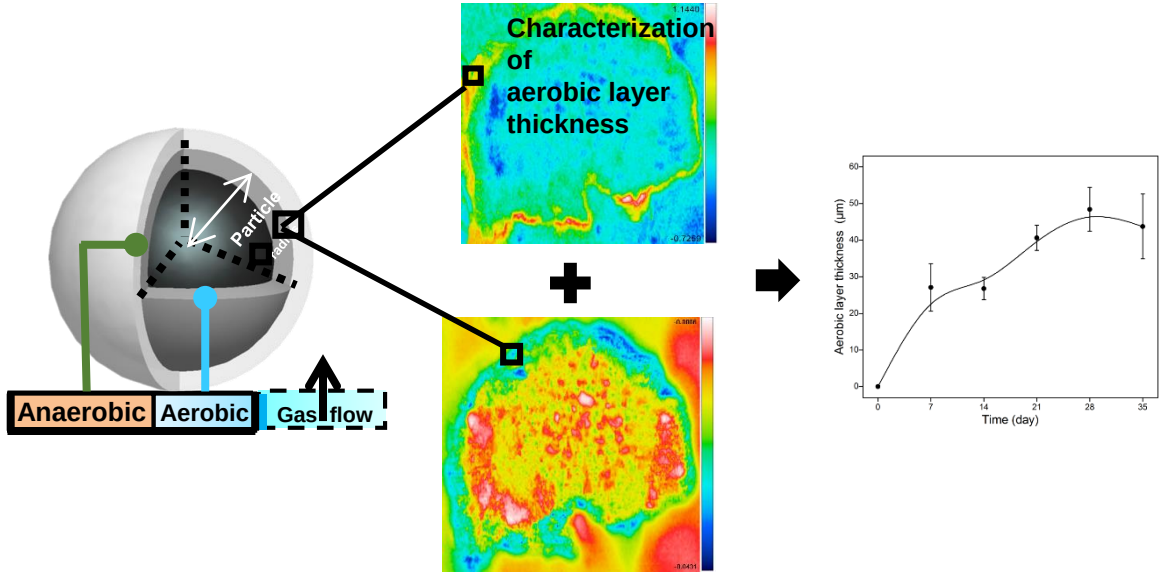
Representative straw and manure 10000 samples

Characterization

- Chemical composition
- Proximate and ultimate analysis
- Thermal properties
- Physical and mechanical properties

Agro-biomass database

Low Greenhouse Gas (GHG) Emission Manure Composting on Multi-scales



Agricultural value chain mapping

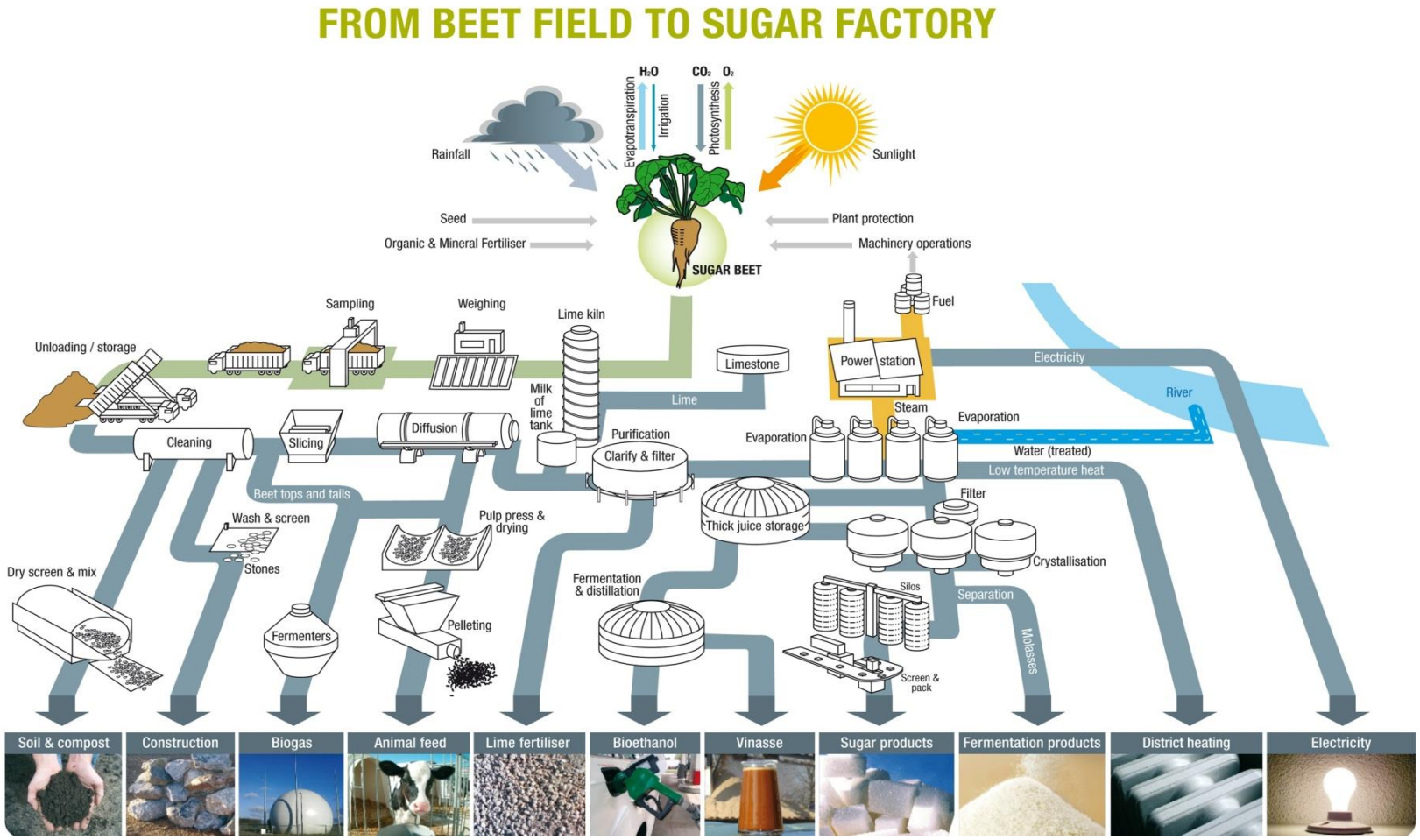
- Selected 26 commodities (grass and forest excluded)
- Commodities and project Report are divided into four groups: Animals, Cereals, Fruits, Vegetables
- Time period for data coverage: 2010 – 2014, in some cases extension till 2015 and 2016
- Value chain for each commodity is created and AWCB is analysed and calculated
- Example - animal value chain

- Total quantities of the AWCB's for EU28 are calculated and presented in diagrams and tables on a country level

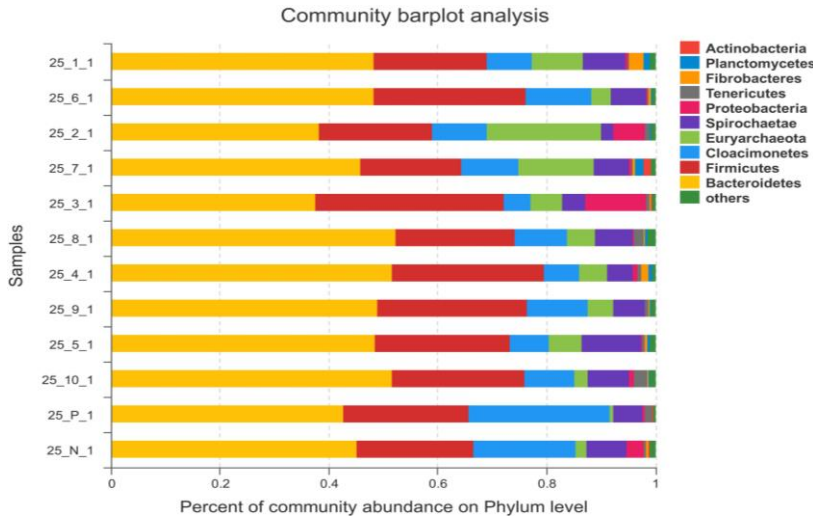
- Filling in data collection sheet detailing generation & management of different Agricultural Waste, Co-products & By-products (AWCB)

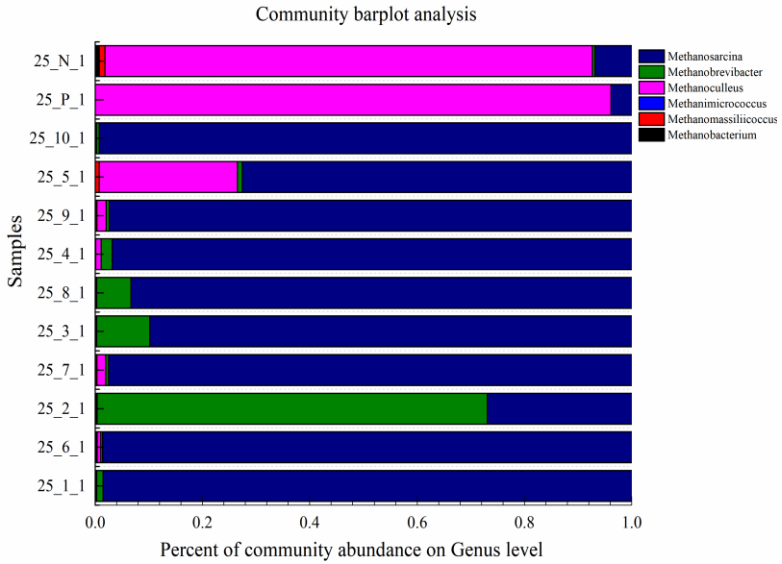
- Established a solid database & good overview of the current state of play: needs to be updated regularly

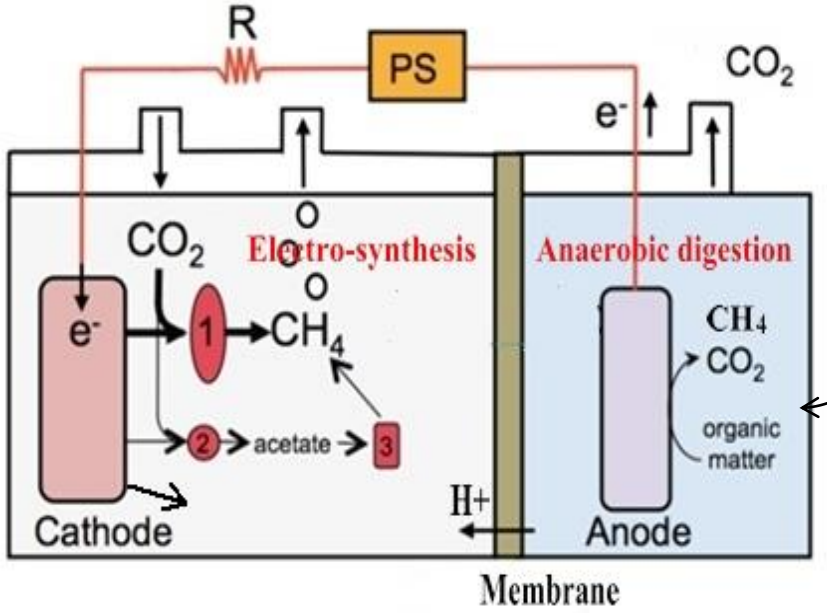
- Better understanding of the differences between AWCBs, which may include actual products & even value added products



- Biogas demonstration project was built in Nanjing Tech University Campus.
- Integration of bioelectro-chemical systems and anaerobic digestion system for energy recovery and environment remediation.
- Total biomethane production increased by 43.47% compared with the MFC.







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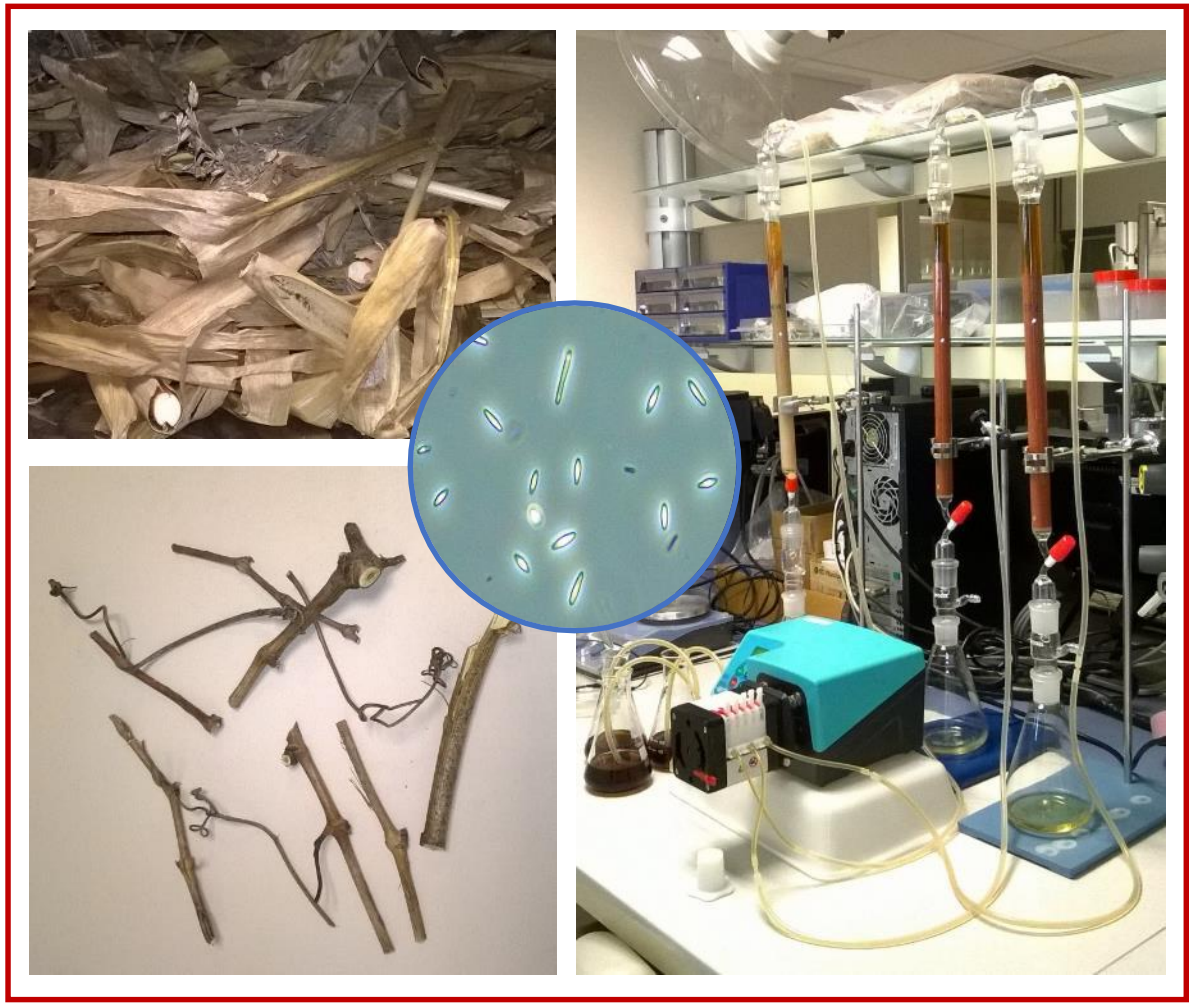
INSTITUTO TECNOLÓGICO AGRARIO

Junta de Castilla y León

- Corn stover and vine shoots were assessed as feedstocks for biobutanol production.
- Raw hydrolysates were fermented and produced 4-6 g/L butanol.
- After a detoxification process with polymeric adsorption resins, corn stover hydrolysates yielded 9 g/L butanol.



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IPCF

- Pilot scale production of demonstrators made of polymeric biocomposites containing potato pulp fibres as filler

- Potato pulp fibres up to 20 wt% were added to Poly(lactic acid) (PLA) and Polyhydroxyalkanoate (PHA) based matrices

- PLA and PHA based biocomposites with potato pulp fibres can be used for industrial production of pots or rigid containers for applications in packaging and agriculture

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MANOR FARM
IRISH CHICKEN

Harper Adams University

- Positive engagement with industry to advance technology development
- Developing technologies that have future real-world application
- Demonstrating possible technologies to improve valorisation of agricultural wastes to recover useful by-products

Left – PlanET wet AD system in the UK

Right - Alchemy Utilities Ltd dry AD technology in Ireland

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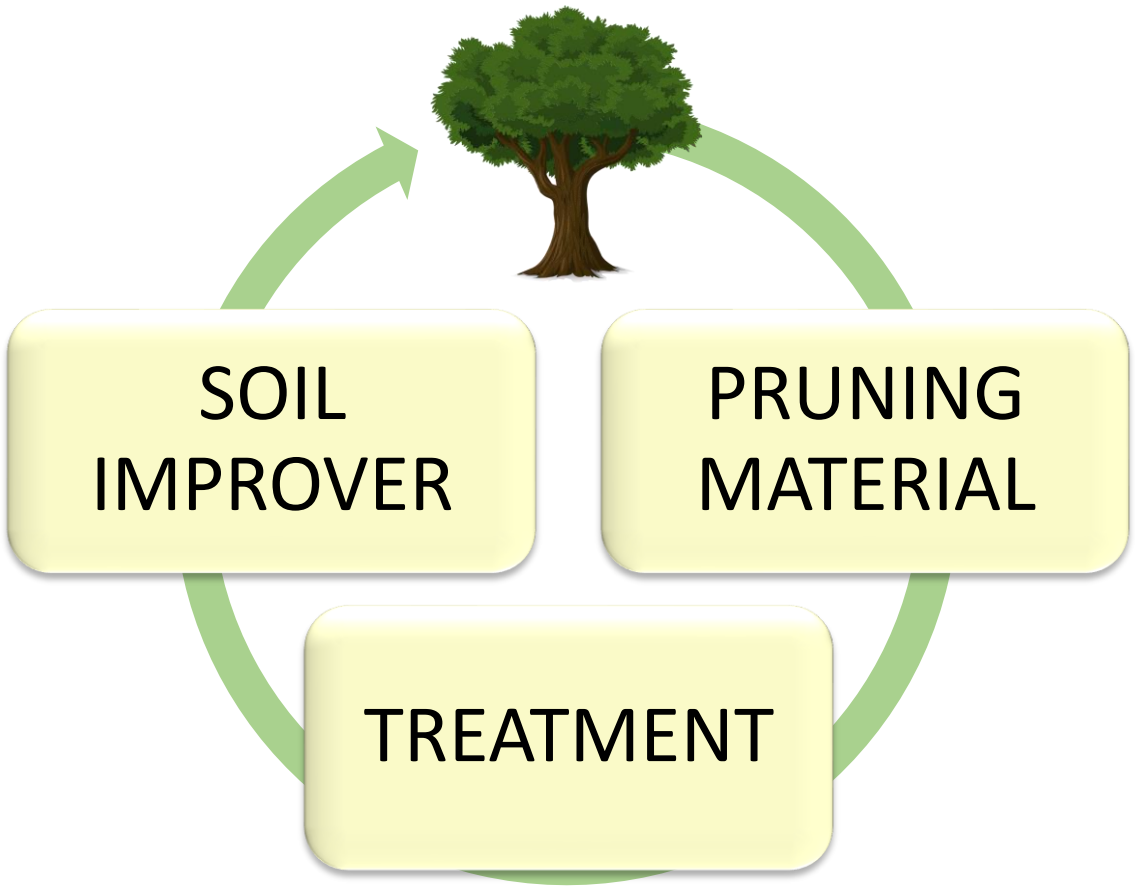
UNIVERSITEIT GENT

AXEB
BIOSTIMULANTS & PLANT NUTRITION

- Soil improver from pruning waste material tested by AXEB (Spain) and University of Gent (Belgium). Experiments ongoing.

- It helped AXEB to improve product development strategy.



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Fraunhofer IVV

Potato protein based food packaging films produced on industrial scale pilot plant:

- **PET** 12µm Hostaphan RNK 12 / Potato protein / Novacote ASL 120 / **PE** 10µm defa *Conventional multi layer film*

- **Paper** B5B TDM / Potato protein / Novacote ASL 120 / **PLA** 30µm Nativa *Fully biobased renewable film*

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HELLENIC AGRICULTURAL ORGANIZATION "DEMETER"

- DEMETER developed an innovative formula for Rice Bran Biofertilizer (RBBf) consisted of 74% rice industry residues. The RBBf can replace any fertilizer in low input of organic rice or wheat farming systems (tested). Furthermore, needs to be tested in vegetable crops.

RBBf automatic compost bin

Drone image showing the different RBBf treatments

- Development of novel Bread and Digestive Biscuits fortified with rice bran, rich in dietary fibres and antioxidant content. The rice bran was stabilized using an innovative infrared stabilization technique developed in DEMETER.

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CERTH
CENTRE FOR
RESEARCH & TECHNOLOGY
HELLAS

- Design and construction of a hybrid anaerobic SBR/aerobic MBR for fruit processing wastewater treatment.
- Pilot demonstration in a fruit processing industry during 2018 production period.
- Main Results: reduced energy consumption, biogas recovery and high quality effluent.

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exergy
Engineering that inspires

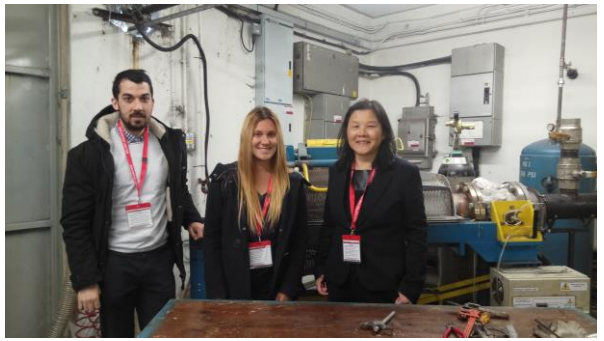
- **Coordination** of WP2 has been a fruitful and positive experience with loads of learning in **biofuel** area

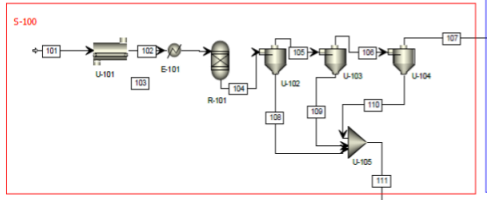
- **Pyrolysis** of forestry residues, with the support of Sheffield University

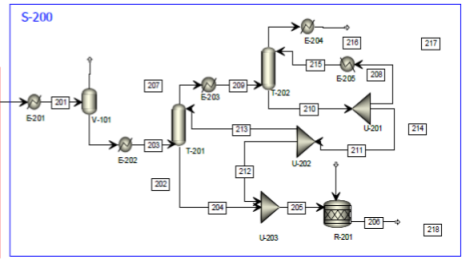
  ✓ Demonstrated the **potential** of three biomasses to produce different sources of **energy** (**fuels and electricity**), and even chemicals

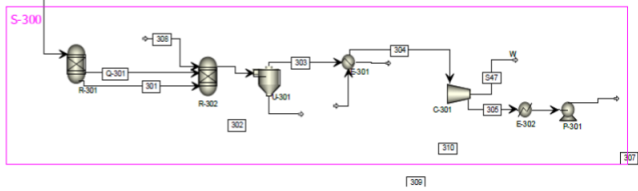
- **Microbial Fuel Cell** in UK, with the collaboration of Bath University, and in parallel to the development of the technology in China (Nanjing Tech. University)

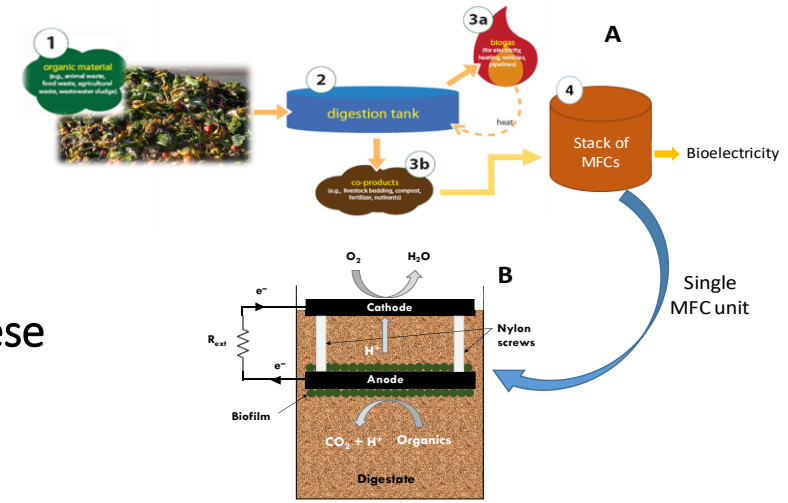
  ✓ **Strengthened the collaboration with Chinese partners** in the field of MFC and bioremediation

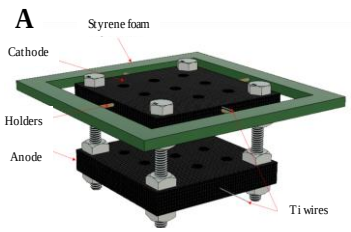


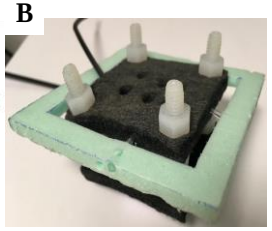












AgroCycle Kids

Delivered AgroCycle Kids Bespoke Curriculum in Ireland

Resources available through AgroCycle Kids from November 2018, for teachers, guardians, children:

- Lesson Plans
- Science and Environmental Animation
- Online Games
- Rap song etc.

AgroCycle Kids information disseminated via E-newsletter to 300,000+ readers and university publications and radio interviews

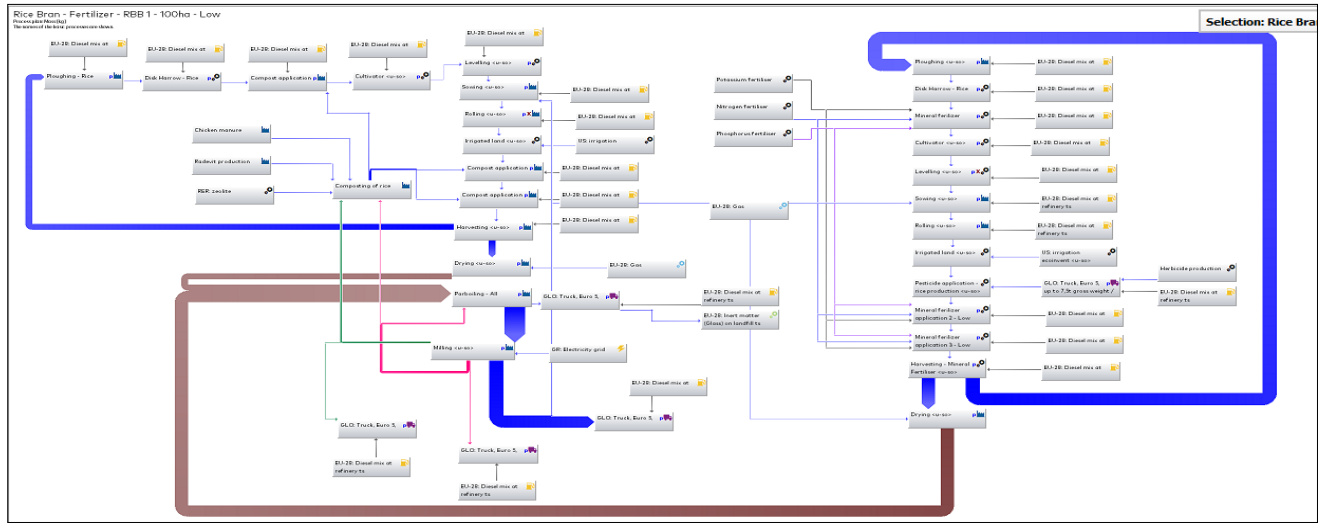
Aspects of the overall AgroCycle Kids programme delivered to Chinese primary school children in The Affiliated Primary School of Beijing Forestry University.

AgroCycle Kids Bespoke Curriculum delivered at international conferences:

- Columbia University, New York at the International Conference for Sustainable Development
- Gavle University, Sweden and the Association of Teacher Educators of Europe

Sustainability Analysis

- AgroCycle protocol specifies rules for carrying out LCA, for example data requirements.
- Includes Social LCA; Life Cycle Costing; Environmental LCA
- 4 Case studies
  - Rice bran/husk via composting as a fertiliser
  - Corn Stover to produce biobutanol
  - Potato pulp to produce biocomposite
  - Wastewater via AD to produce energy; fertiliser; single cell protein and clean water.



AgroCycle Kids Video

- AgroCycle Video developed with Carr Communications
- Allowed us to refine our communication message
- Video has been viewed >400 times

https://youtu.be/359ibQ4ozz0