



R&D INNOVATION CENTRE “ALFONSO MAÍLLO” CiAM

DIRECCIÓN DE INNOVACIÓN DE URBASER



ER-0084/1997

GA-1999/0157

GE-2008/0002

IDI-0030/2006

URBASER's BUSINESS GROUP

Nº 1
Waste treatment in Spain

Nº 2
Urban Services in Spain

Nº 1
Regeneration of oils in the Iberian Peninsula

Nº 1
Anaerobic digestion in the world

Presence in 21 countries

Unique R&D&i center in Europe



URBASER's BUSINESS GROUP: Business areas



Urban services

- Waste collection
- Beach and street cleaning services
- Green areas management
- Energy efficiency
- Management of sport facilities
- Waste valorisation, construction and demolition

- Water collection and distribution
- Water treatment and sanitation
- Sewer network
- Municipal wastewater treatment
- Analytical control
- Users commercial management



Municipal solid waste treatment

- Complete urban waste plants
- Segregation of recyclable waste materials
- Anaerobic digestion plants
- Composting plants
- Energy valorisation
- Transfer stations and clean points
- Controlled waste disposal
- Controlled degasification

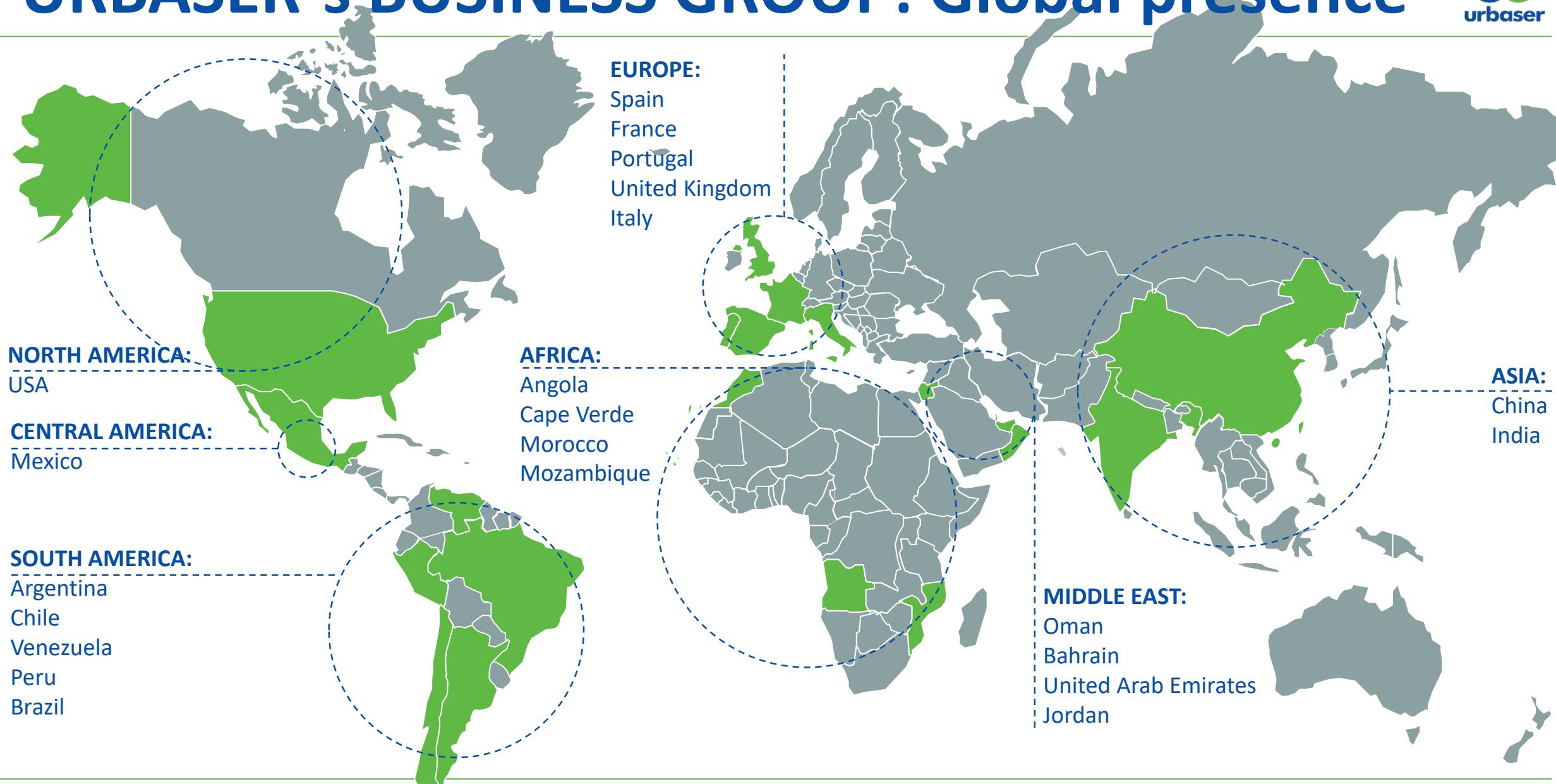
- Waste removal
- Used oil regeneration
- Fuel recovery
- Transfer stations
- Controlled waste disposal

Waste treatment

Integral water management

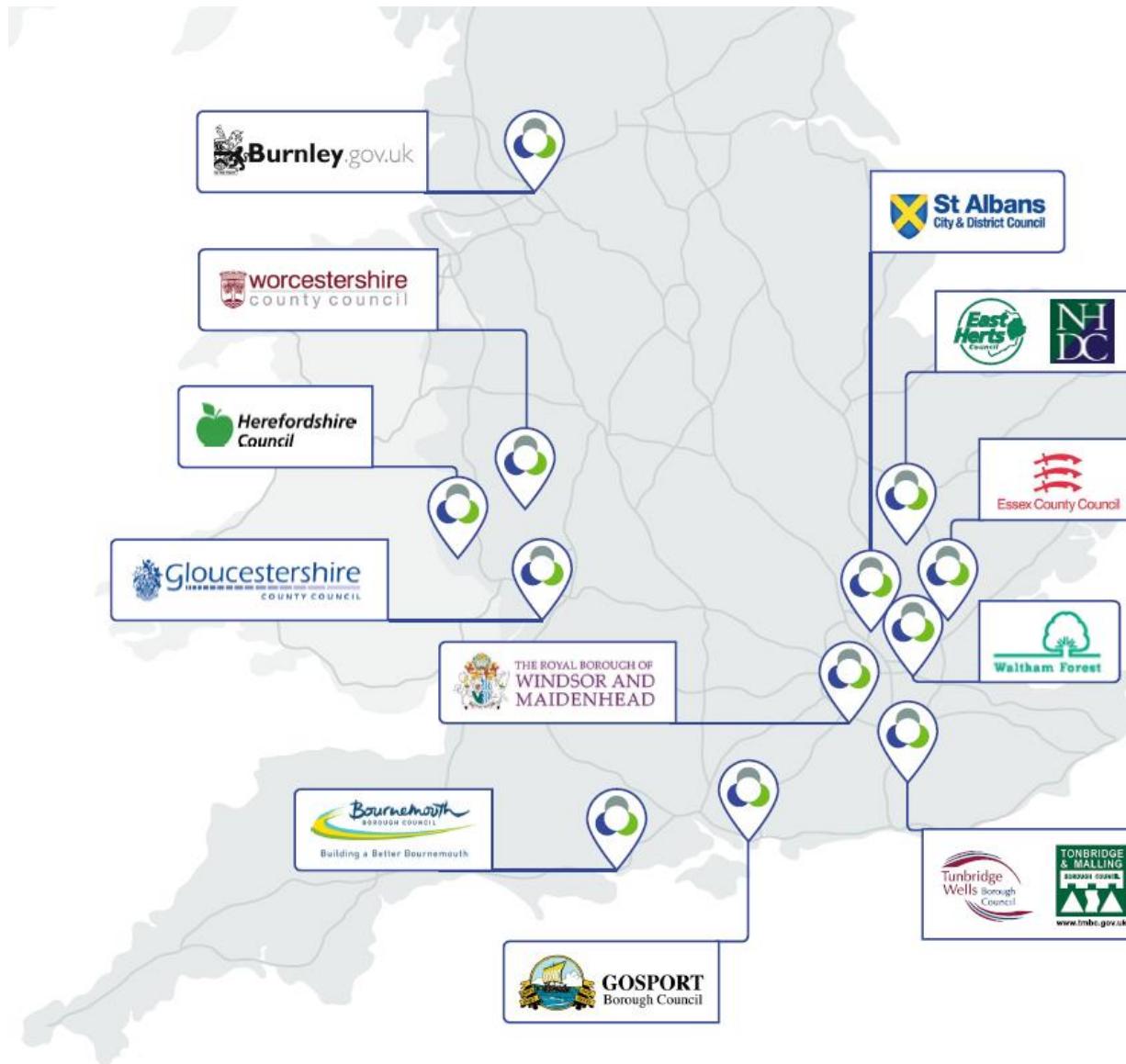
Industrial waste treatment

URBASER's BUSINESS GROUP: Global presence

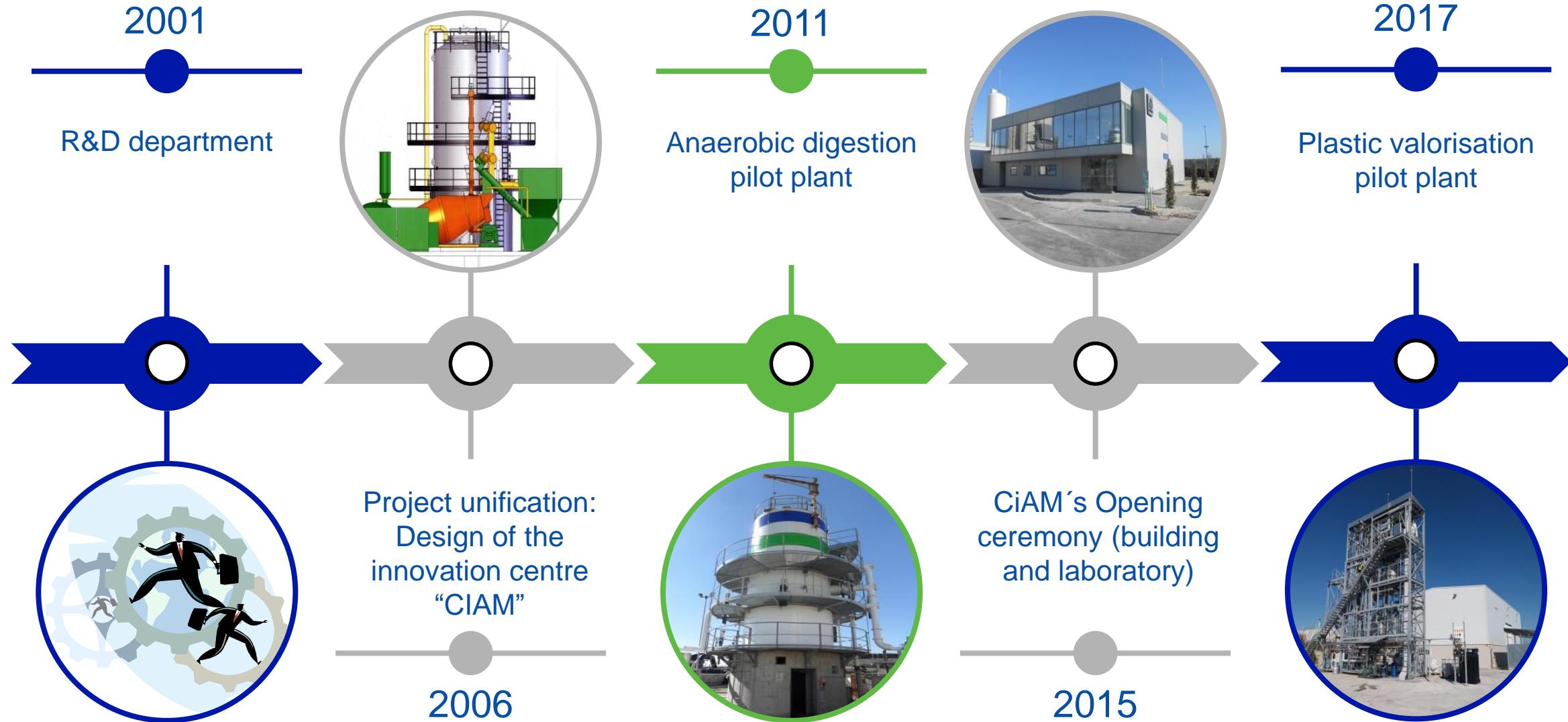


URBASER in the UK

Urbaser Ltd's UK Municipal and Waste Treatment contracts



R&D Department History



CiAM's Location



R&D&innovation Centre located in Zaragoza, Spain.

8 M€ INVESTMENT

- ✓ PILOT PLANTS
- ✓ ADMINISTRATIVE BUILDING
- ✓ LABORATORY
- ✓ TESTING BENCH

QUALIFIED STAFF



CiAM's Mission



Increase the innovation culture of URBASER's Business Group: Leader company in waste management

Development of advanced infrastructure to conduct R&D projects at prototype scale in a relevant environment for technology validation and demonstration

Achievement of environmental and economical improvements

CiAM's Research Areas

BIOLOGICAL PROCESSES AREA



Anaerobic digestion
Composting plant

THERMOCHEMICAL PROCESSES AREA



Green Diesel production

LABORATORY



Monitoring of pilot and
industrial plants



Horizon 2020
European Union Funding
for Research & Innovation



Demonstration of an integrated innovative biorefinery for the transformation of municipal solid waste (MSW) into new bio-based products

Alba Serna-Maza(asernam@urbaser.es)
URBASER S.A.



The URBIOPFIN consortium

Research Project Budget: 15 M€

Duration: 4 years project (6/2017 – 5/2021)

 IMECAL	www.imecal.com/perseo (Coordinator)
 ainia centro tecnológico	www.ainia.es
 urbaser	www.urbaser.es
 Biomasa Peninsular	www.bpeninsular.com

 Universidad de Valladolid	www.uva.es
 exergy Engineering that inspires	www.exergy.uk.com

 WAGENINGEN UNIVERSITY & RESEARCH	www.wur.nl/en.htm
 CIEMAT	www.ciemat.es

 IRTAF Castilla-La Mancha	clamber.castillalamancha.es
 BioEconomy Cluster	www.bioeconomy.de
 SES-Packaging	www.ses-packaging.com



NaturePlast
Bioplastics Expert

www.natureplast.eu



Natrue
www.nattrue.org

The URBIOPFIN objective

NEW MODEL OF OFMSW TREATMENT



Landfill
Composting
Anaerobic Digestion

URBIOFIN -BIOREFINERY

BIO-BLOCKS

- Bioethanol
- Volatile fatty acids
- Biogas

BIO-POLYMERS

- Polyhydroxyalkanoates
- Combined PHA's

ADDITIVES

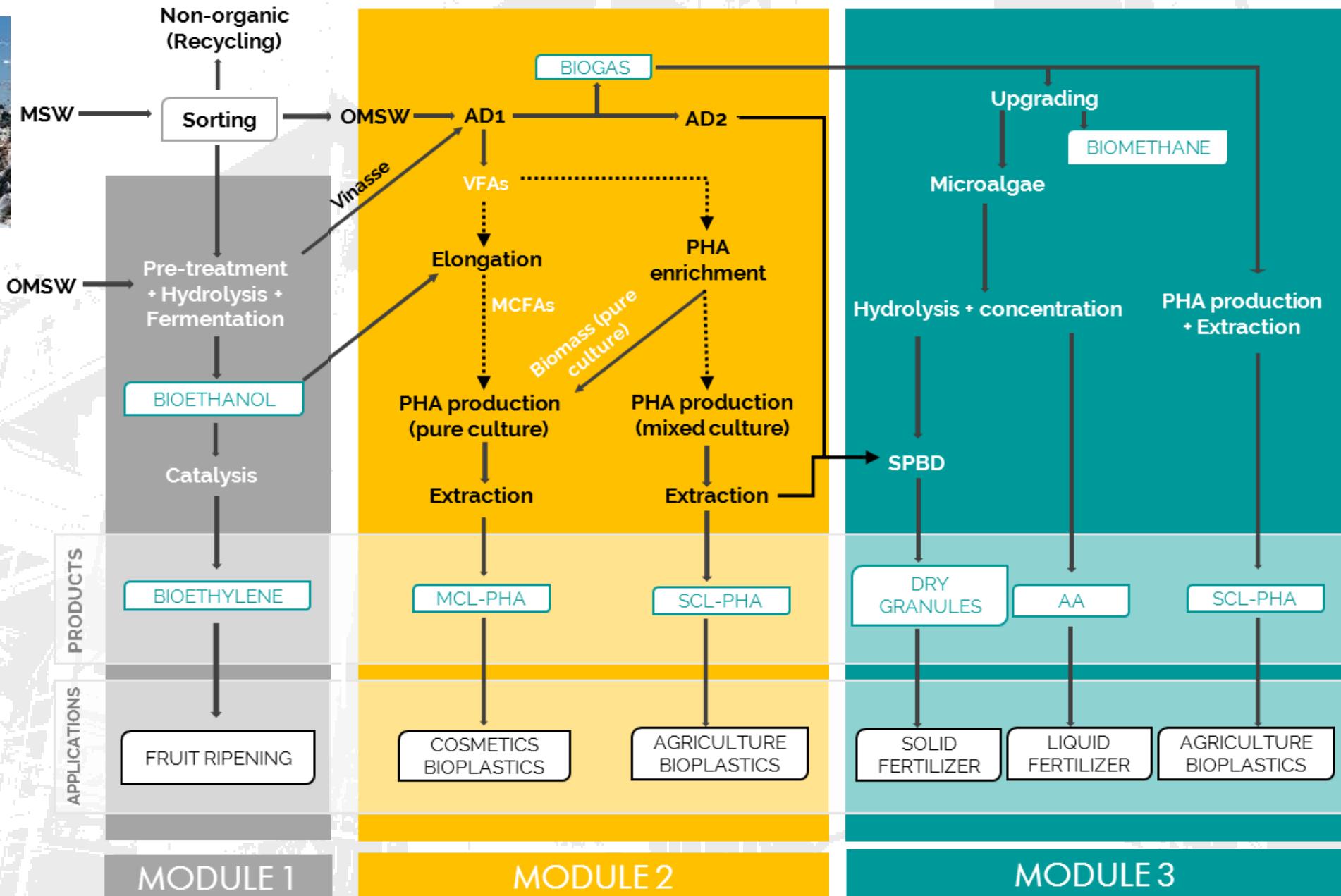
- Bioethylen
- Biochemical products

VALUE



Biorefinery
Multiple bioproducts
Higher value

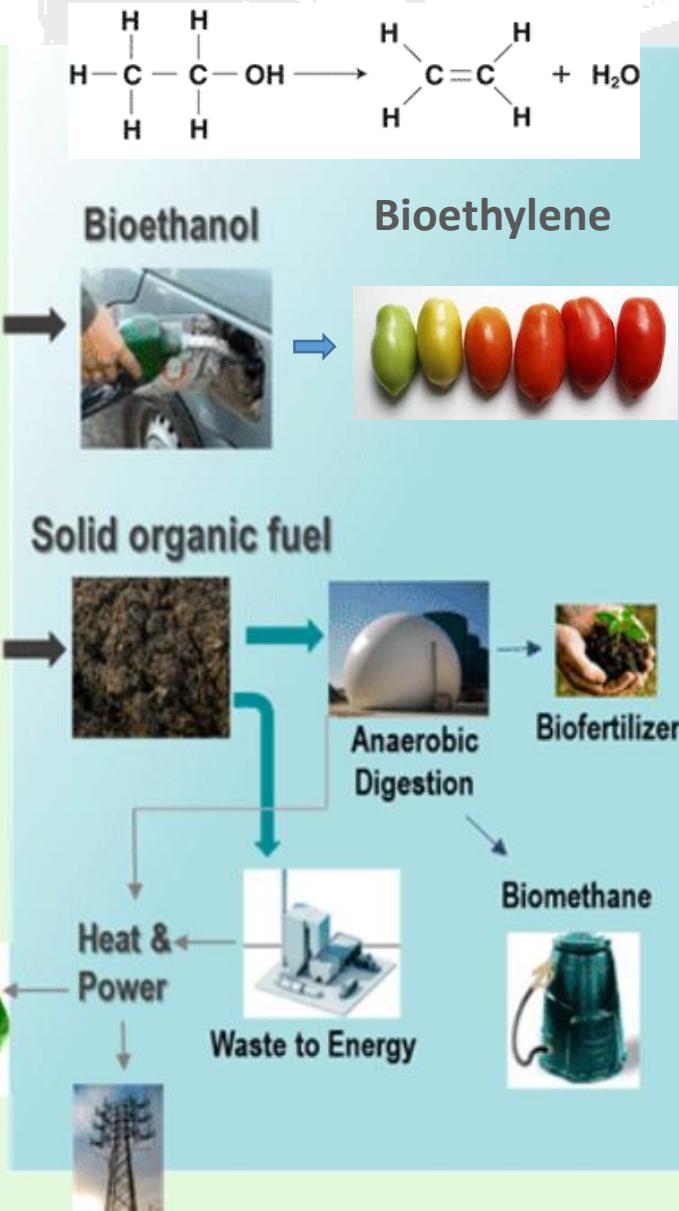
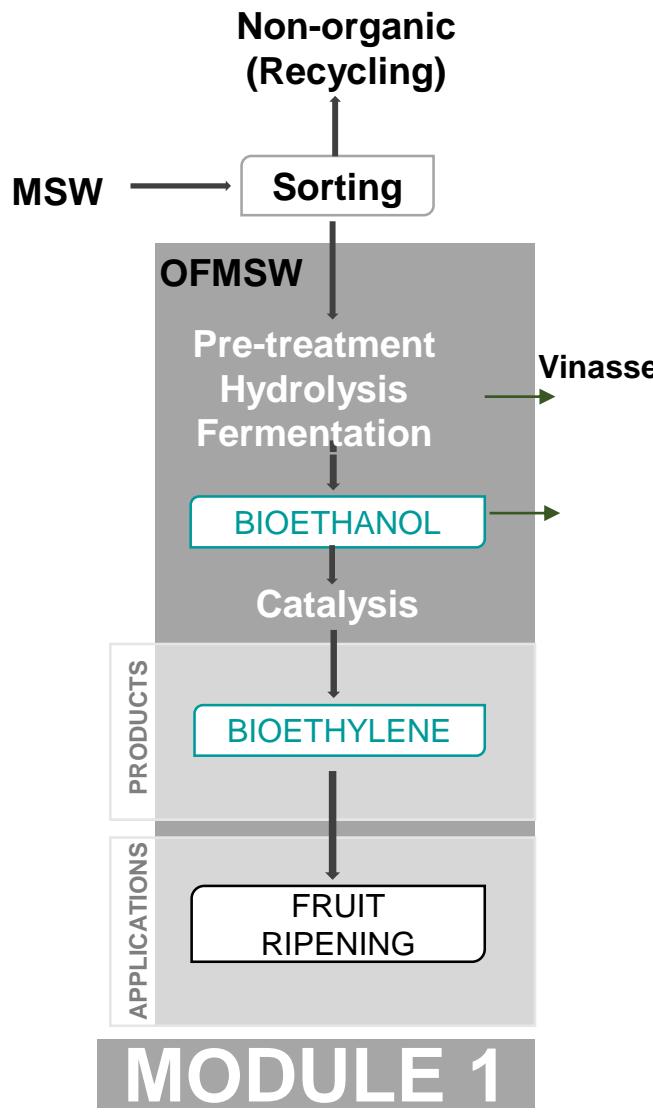




Project Challenges

- ✓ To tackle the issues inherent to MSW treatment, such as variability in composition (seasonality and geographic location) and presence of inhibitors to downstream biotechnological processes
- ✓ To validate the whole value chain at demonstration scale (TRL 5-7)
- ✓ To demonstrate at demo-scale the economic and environmental benefits of the Urbiofin treatment and conversion technologies of the OFMSW into final or intermediate products
- ✓ To validate safety, quality and purity of the products in order to meet commercial and/or regulatory requirements
- ✓ To assess the environmental and socio-economic performance of the whole value chain using a Life Cycle Assessment (LCA)

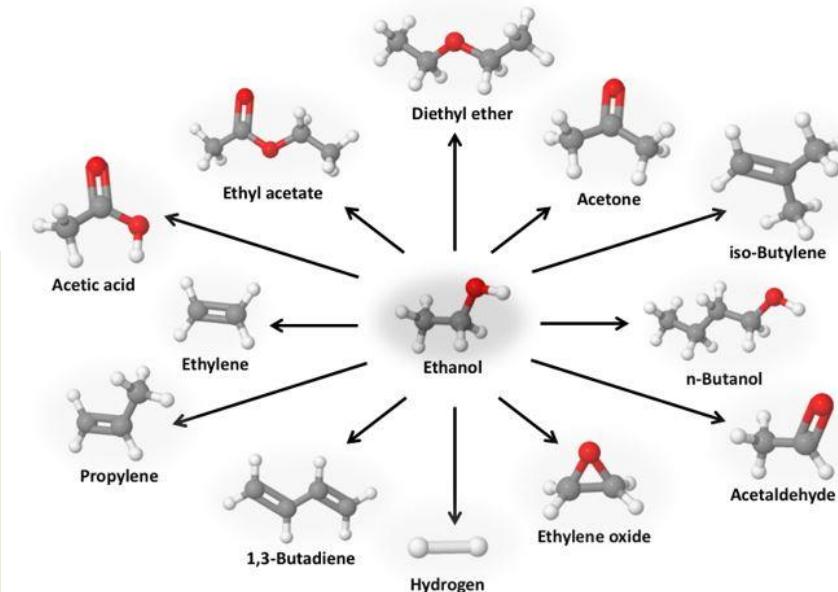
Module I. Conversion of OFMSW to bioethanol and bioethylene



Module I. Market of bioproducts

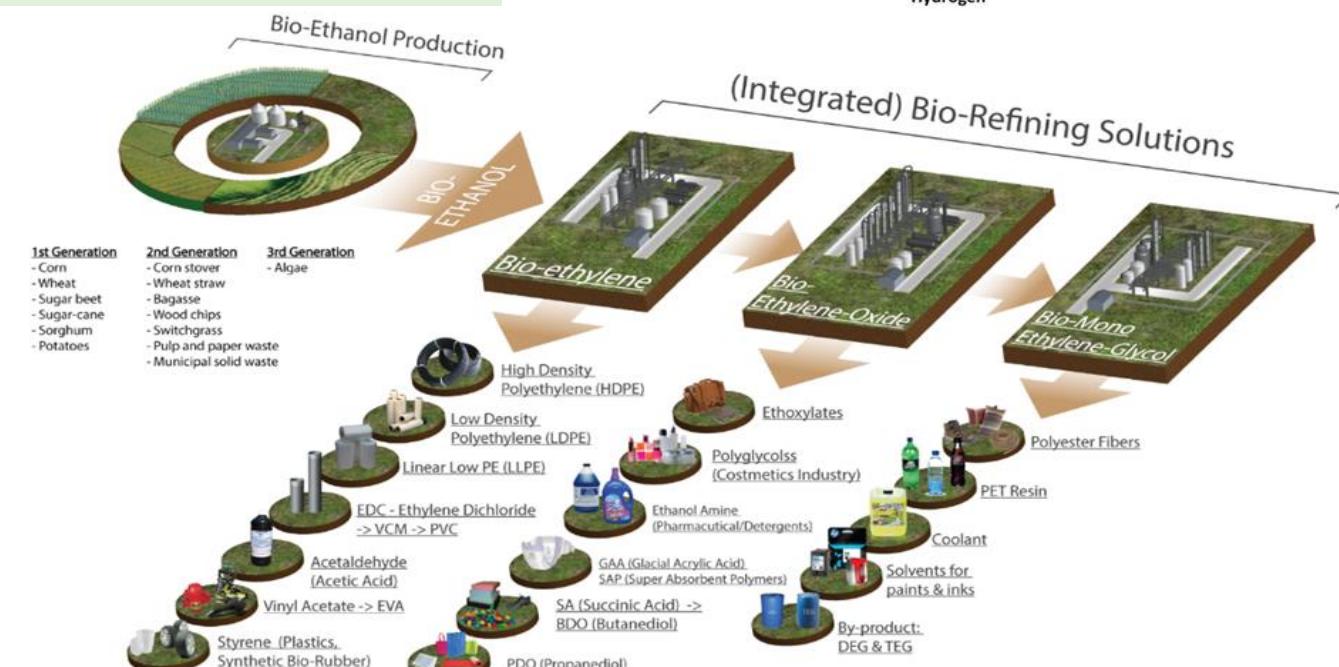
➤ Bioethanol:

- ✓ **Biofuel: 90% of total biofuels.** Market Forecast in Europe: 13 billion € in 2030
- ✓ **Chemical Building block:** Bioethanol is considered as one of the “top 10” potential biobased raw materials for the chemical industry. (US Energy Department)



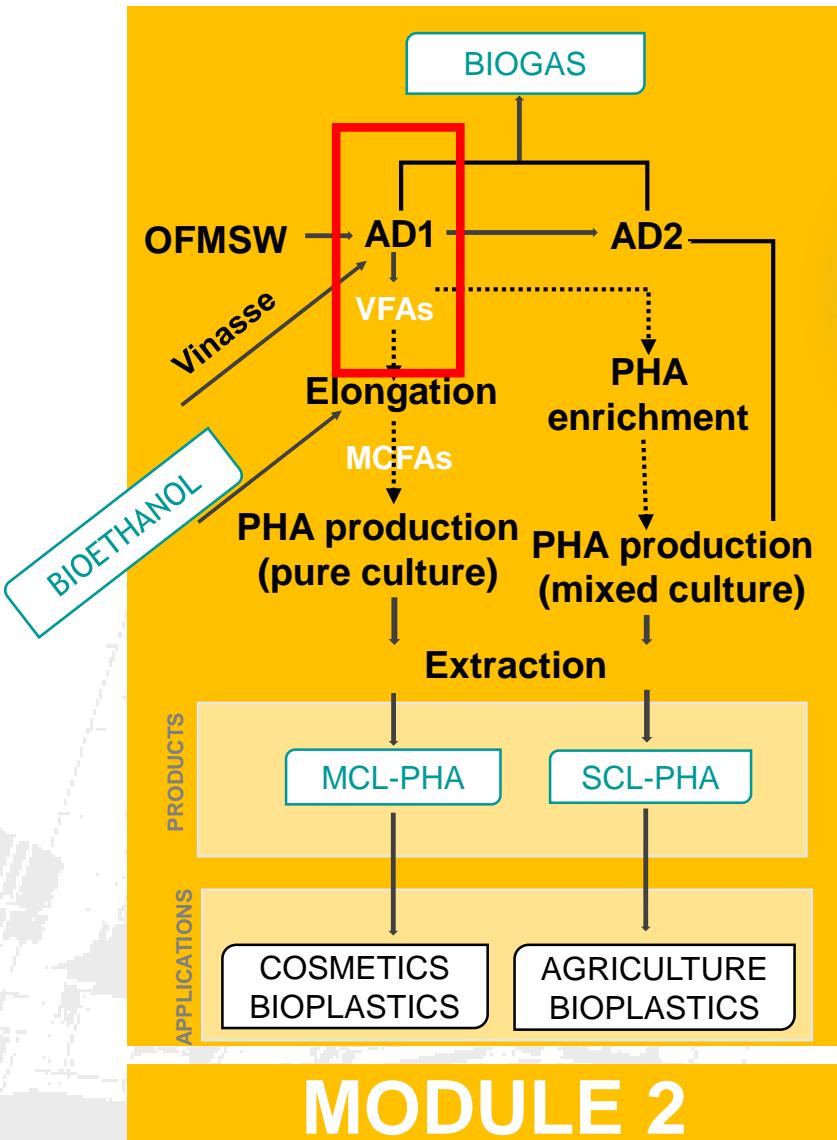
➤ Bioethylene:

- ✓ Global bioethylene market size was over USD 160 billion in 2015 and is foreseen to exceed USD 235 billion valuation by 2024



Module II.

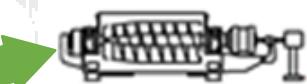
Conversion of OFMSW to VFAs for production of PHA



MODULE 2

Hydrolytic stage
AD 1 = 100 m³

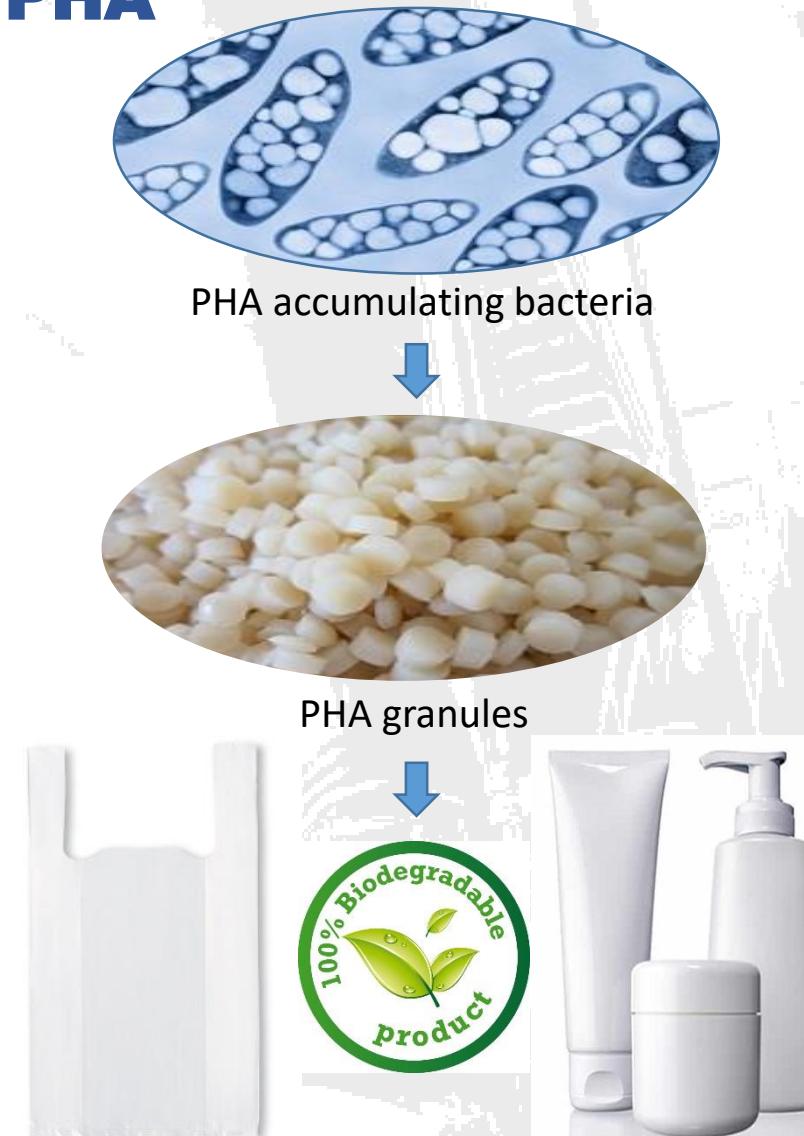
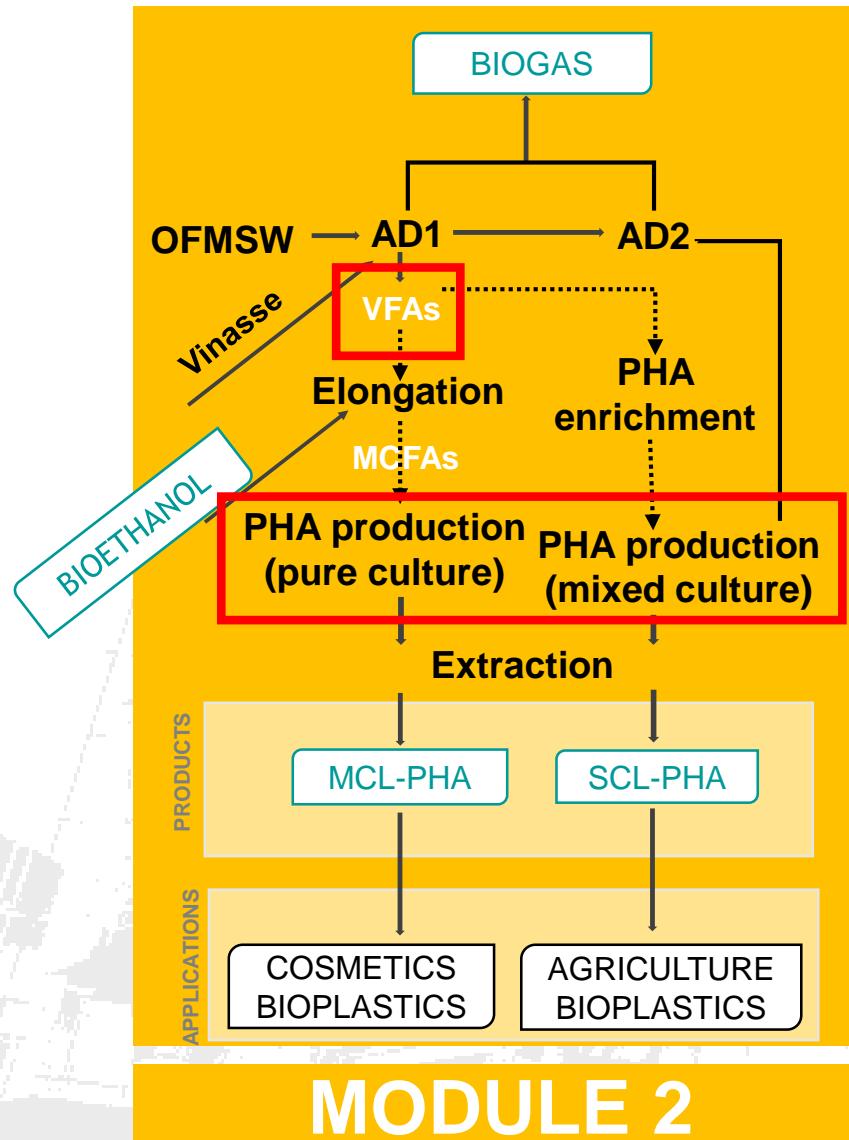
Liquid fraction of
digestate for PHA
production



Hydrolytic cake for
methane
production (AD 2)

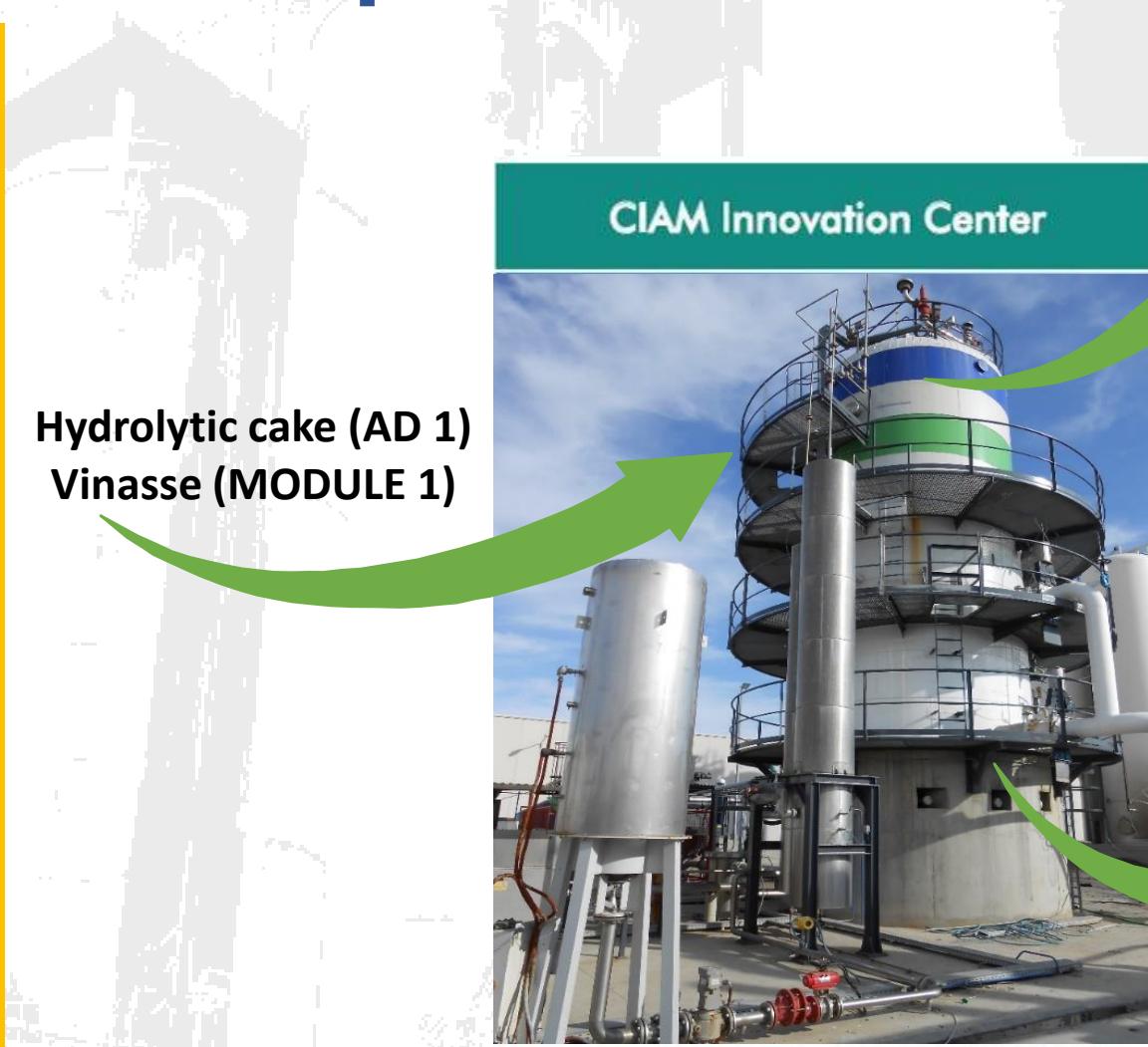
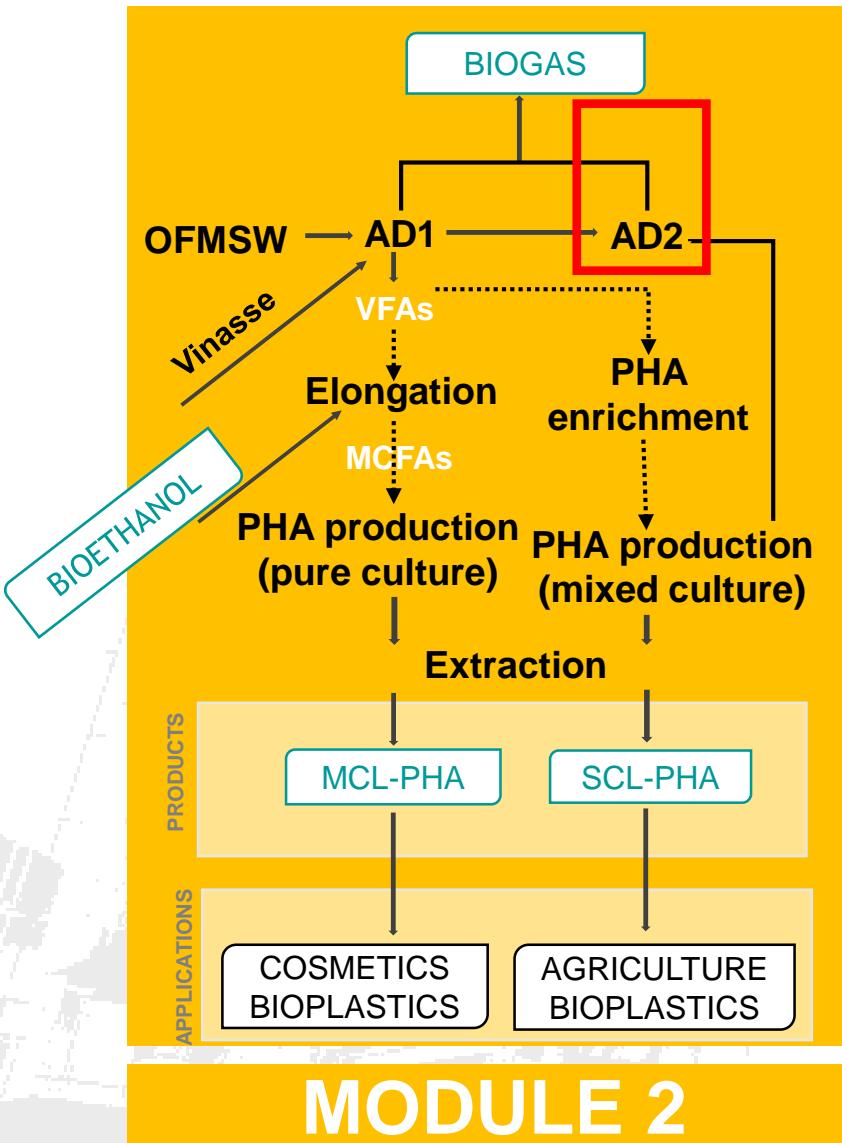
Module II.

Conversion of OFMSW to VFAs for production of PHA



Application: bioplastics

Module II. Conversion of OFMSW to VFAs for production of PHA



Biogas for biomethane
and PHA production
(MODULE 3)

Liquid fraction of
digestate for nutrient
supplementation



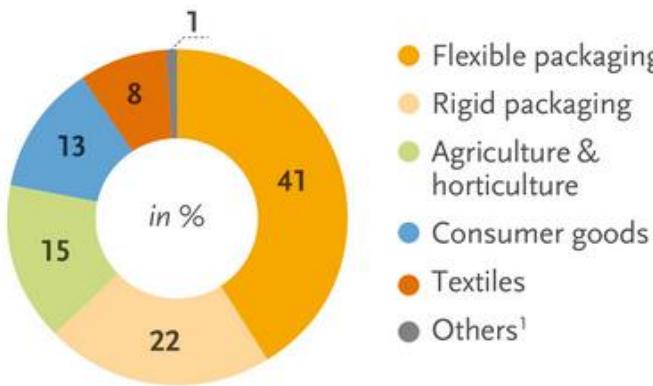
Cake for fertiliser
production
(MODULE 3)

Module II. Market of bioproducts

➤ Bioplastics:

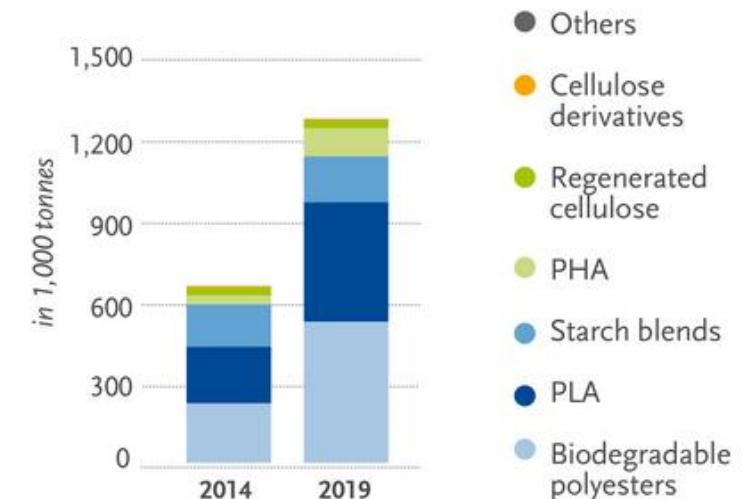
- ✓ Biodegradable bioplastics market is expected to double between 2014 and 2019.
- ✓ In the case of PHA market it is expected a growth from 32 to 104 Mton, mainly related to flexible or rigid packaging and agriculture purposes.

Biodegradable bioplastics markets 2014



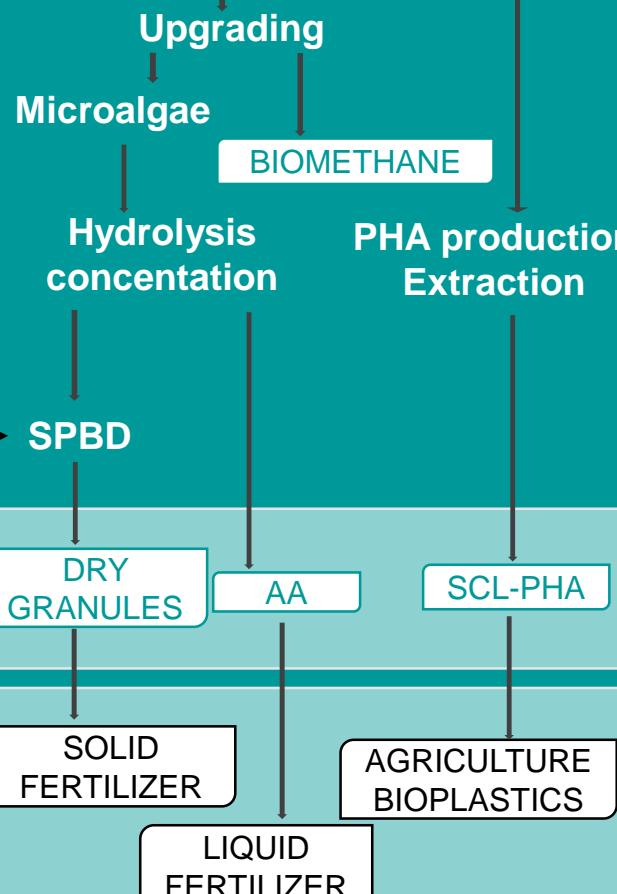
¹ Including electric & electronics

Biodegradable bioplastics 2014 vs. 2019



Module III. Biogas bioconversion to biomethane and added value products

BIOGAS



MODULE 3

CIAM Innovation Center



Methanogenic stage
AD 2 = 40 m³

Bioproducts:

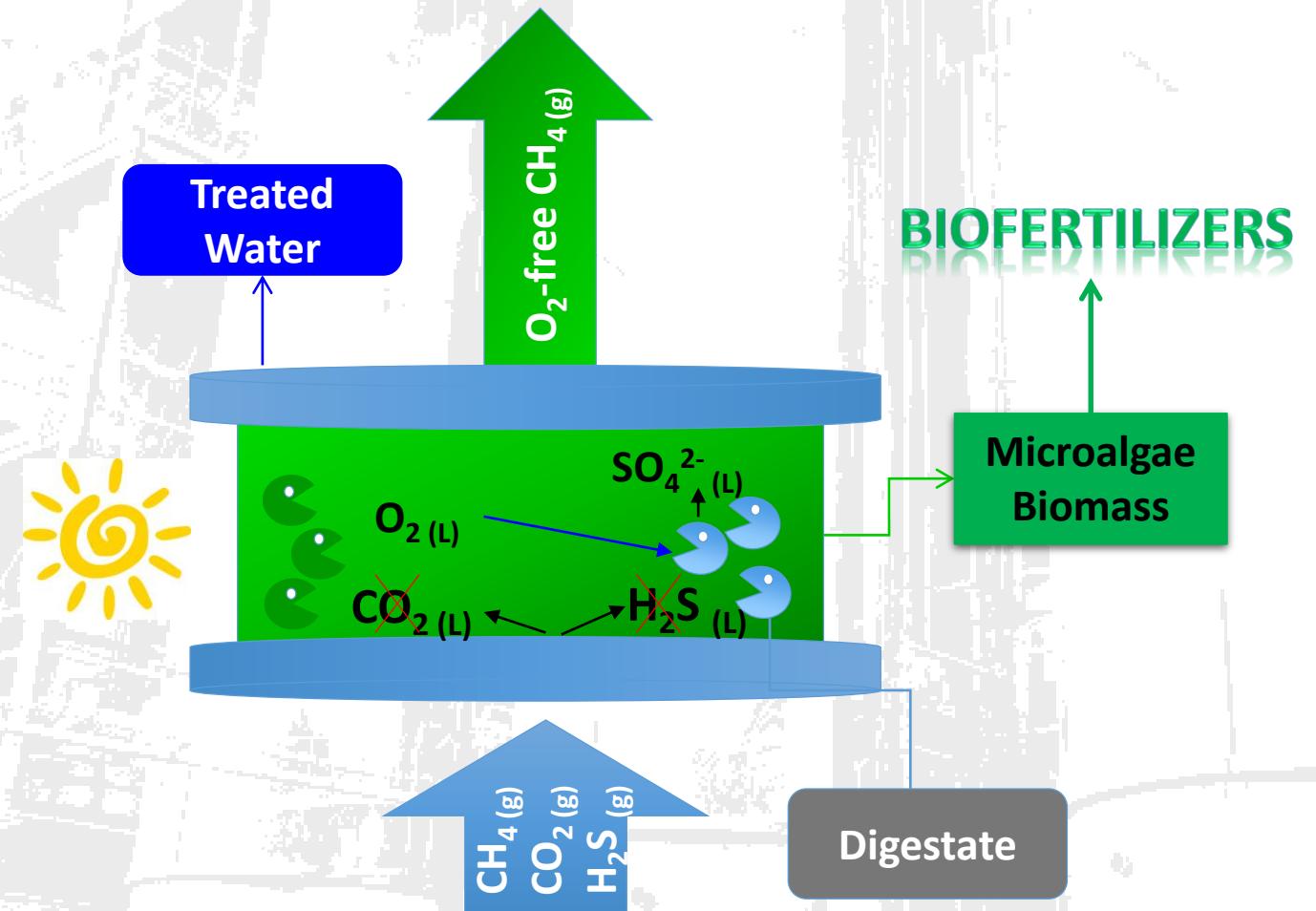


BioPlastic



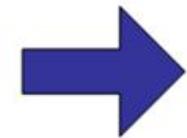
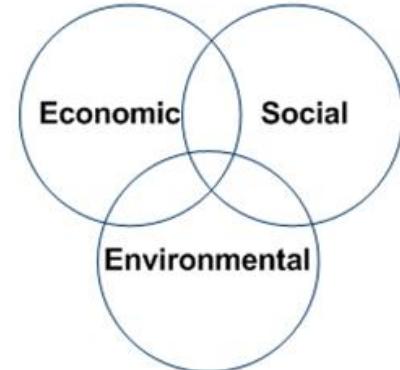
Module III. Biogas bioconversion to biomethane and added value products

Simultaneous Photosynthetic Biogas Upgrading and Microalgae-based Digestate Treatment



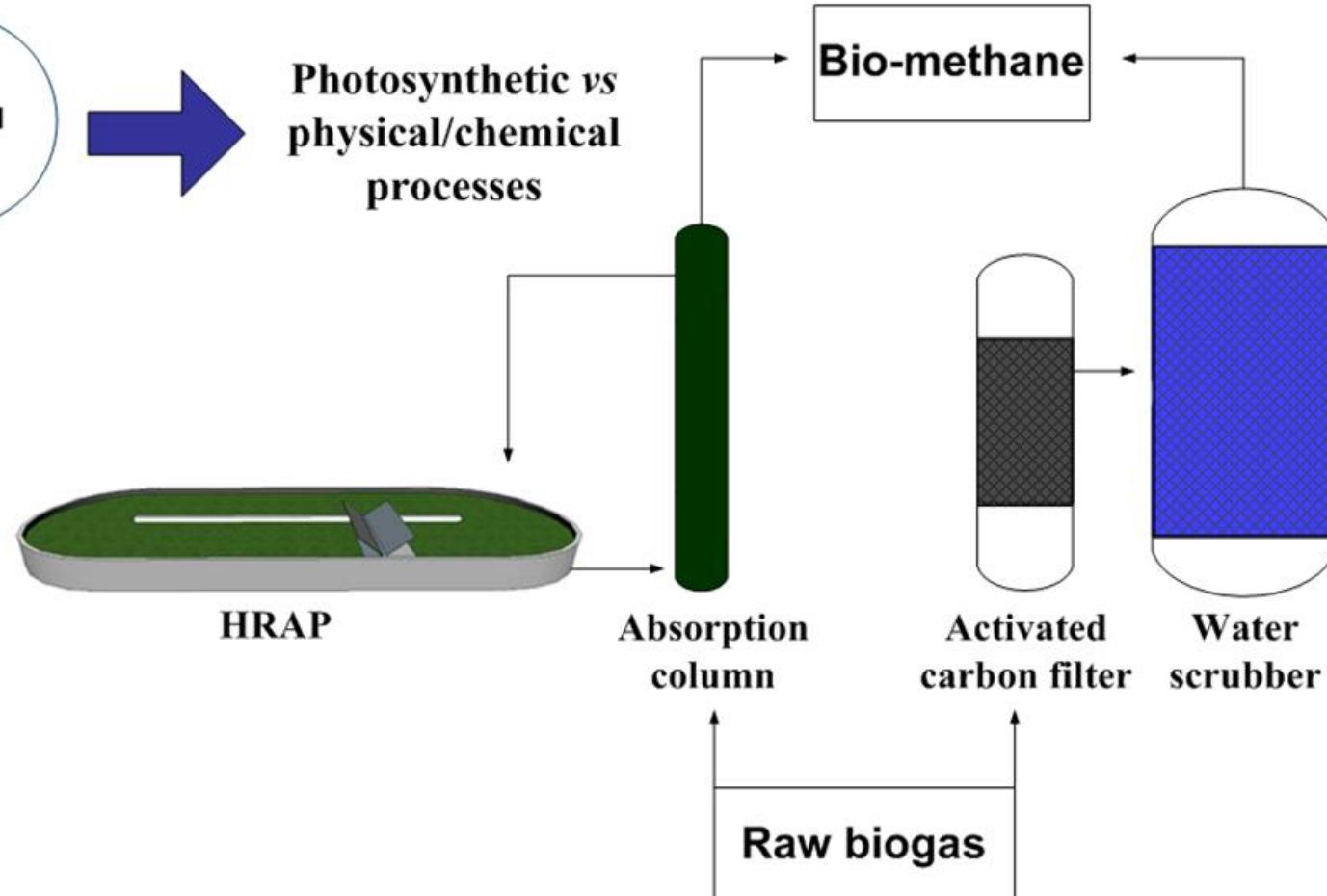
Module III. Biogas bioconversion to biomethane and added value products

IChemE Sustainability Metrics



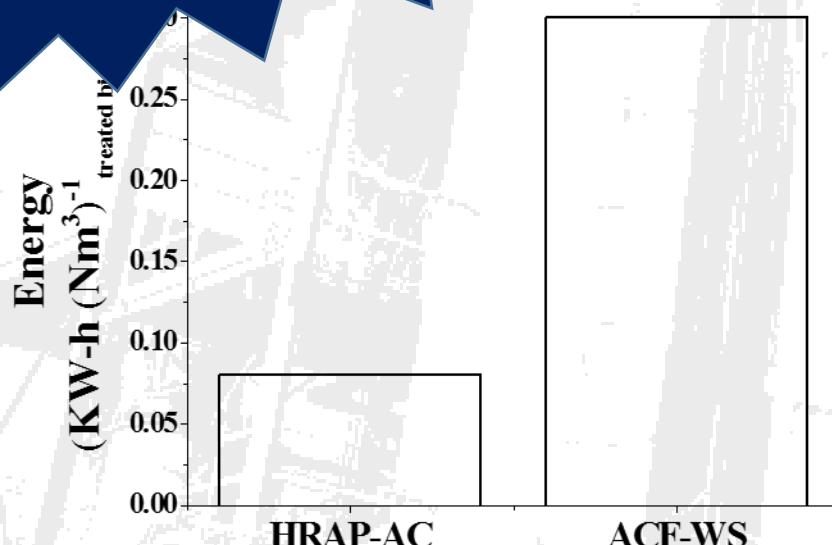
Photosynthetic vs
physical/chemical
processes

$\text{CH}_4 > 95 \%$, $\text{CO}_2 < 1 \%$, $\text{N}_2 < 3\%$, $\text{O}_2 < 0.5 \%$

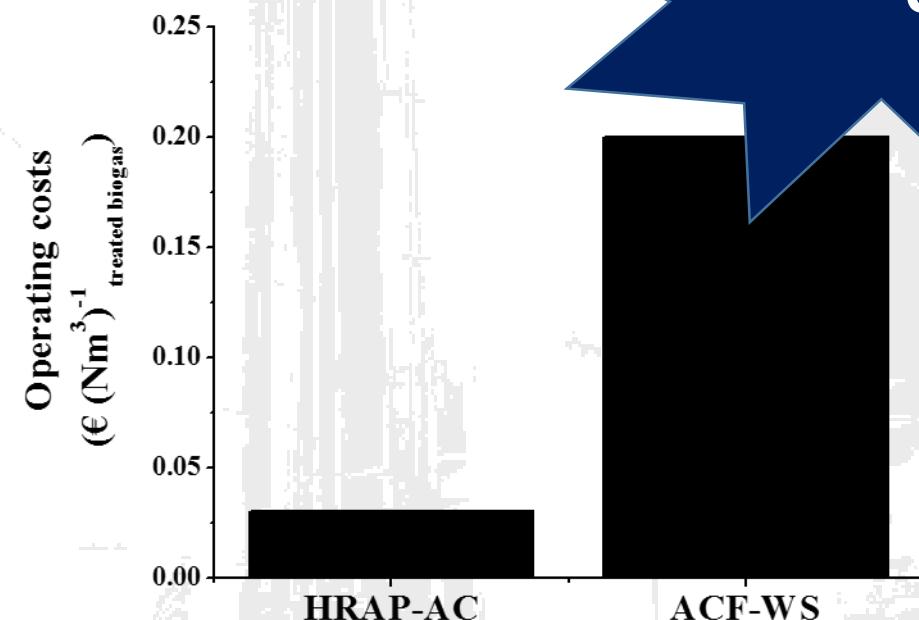


Module III. Biogas Upconversion to biomethane and added value products

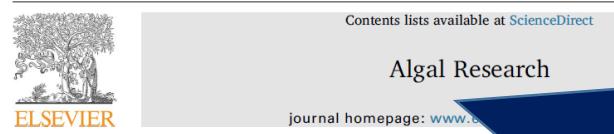
4 times
higher energy
comsuption!!



Operating costs
($\text{\euro} (\text{Nm}^3)^{-1}$)



7 times
higher
operating
costs!!

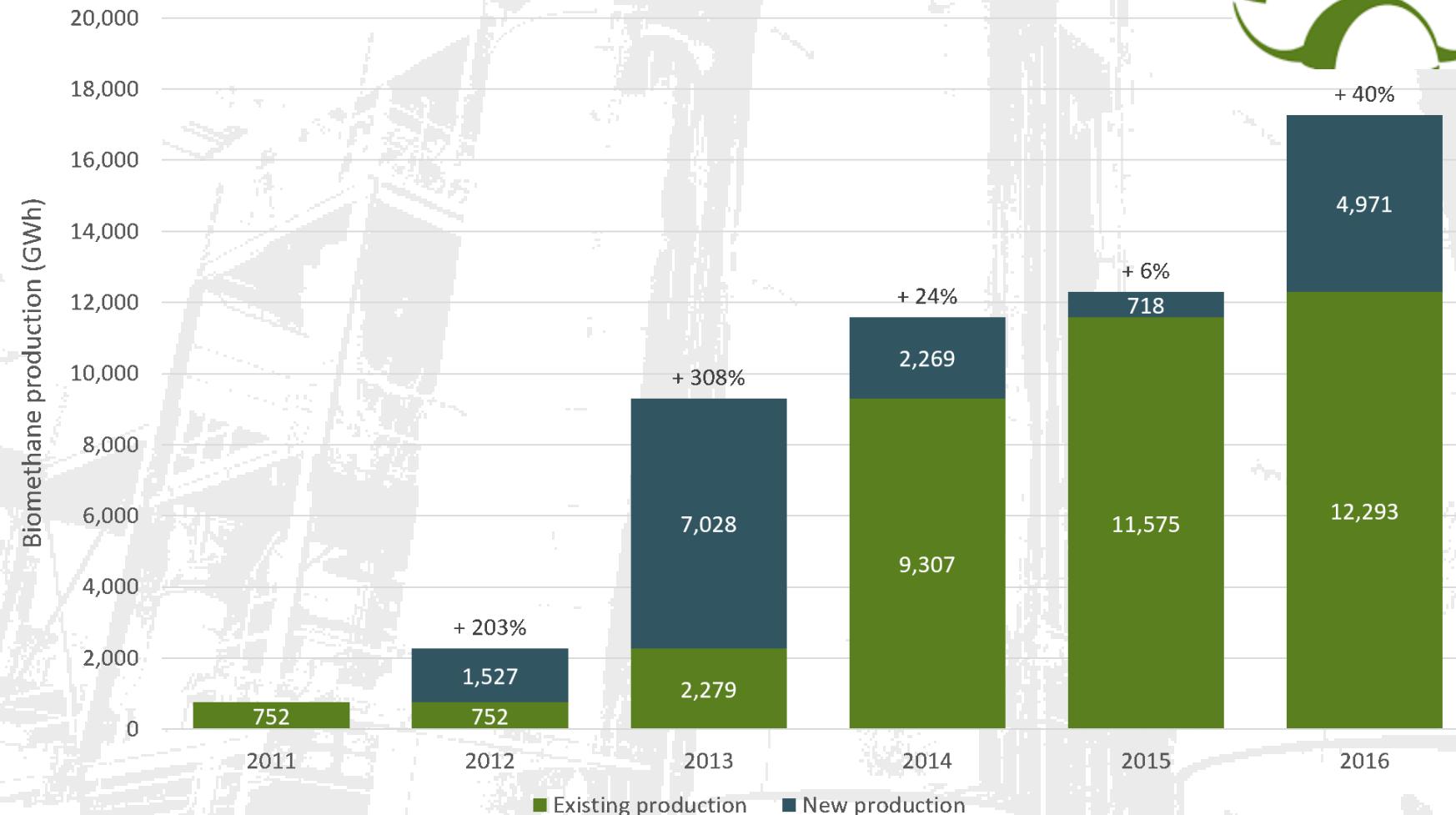


A comparative analysis of biogas upgrading technologies based on physical/chemical processes

Alma Toledo-Cervantes^a, José M. Estrada^b, Raquel Martínez-Gómez^a

Market of bioproducts

➤ Biomethane



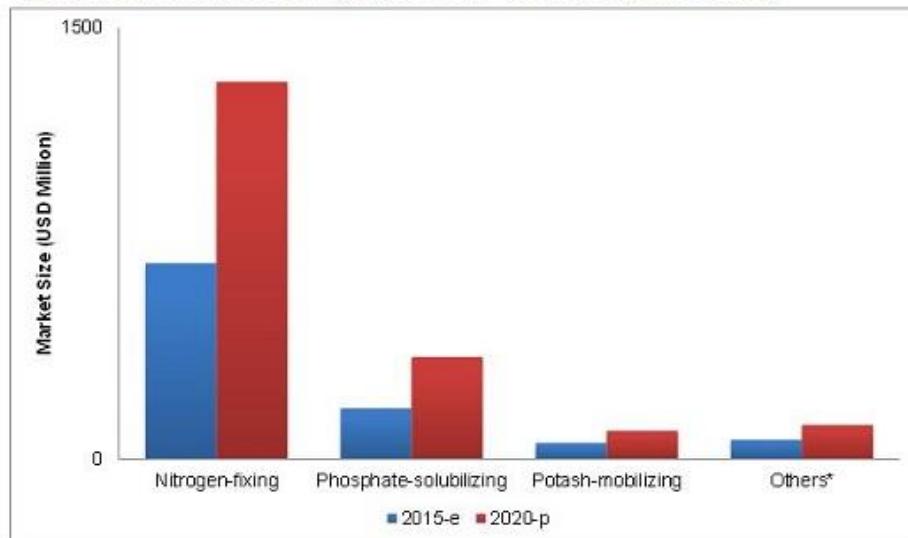
EBA
European Biogas Association

Market of bioproducts

➤ Biofertilizers

- ✓ Global bio-based fertilizers market is expected to reach USD 1.9 Billion by 2020 at a CAGR of 14.0% from 2015 to 2020

Biofertilizers Market Size, by Type, 2015 Vs. 2020 (USD Million)



Advantages of bio based fertilisers vs conventional (mineral) fertilisers

- ✓ It is a recovered / renewable origin bioproduct
- ✓ It improves soil quality/health and not only crop productivity
- ✓ It contains higher components and nutrients concentration
- ✓ It offers easy manipulation and application in field
- ✓ Slow release of nutrients and improved crop yield
- ✓ It reduces the environmental footprint of crop production

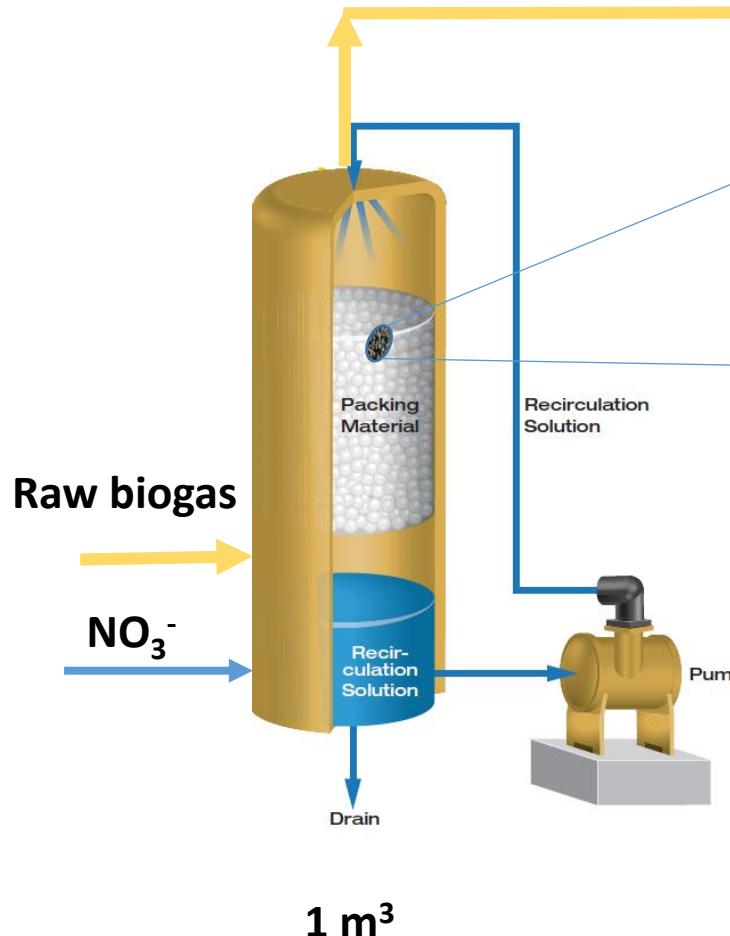
*Others include zinc, boron, and sulfur-solubilizing biofertilizers

E – Estimated; P – Projected

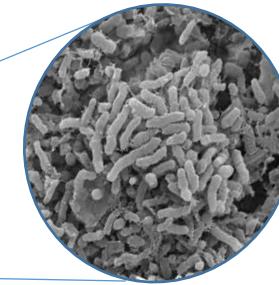
Source: Expert Interviews and MarketsandMarkets Analysis

Module III. Biogas bioconversion to biomethane and added value products

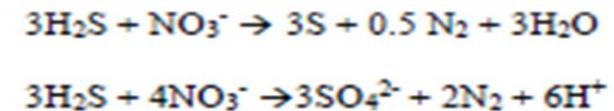
ANOXIC BIOTRICKLING FILTER



H₂S free biogas



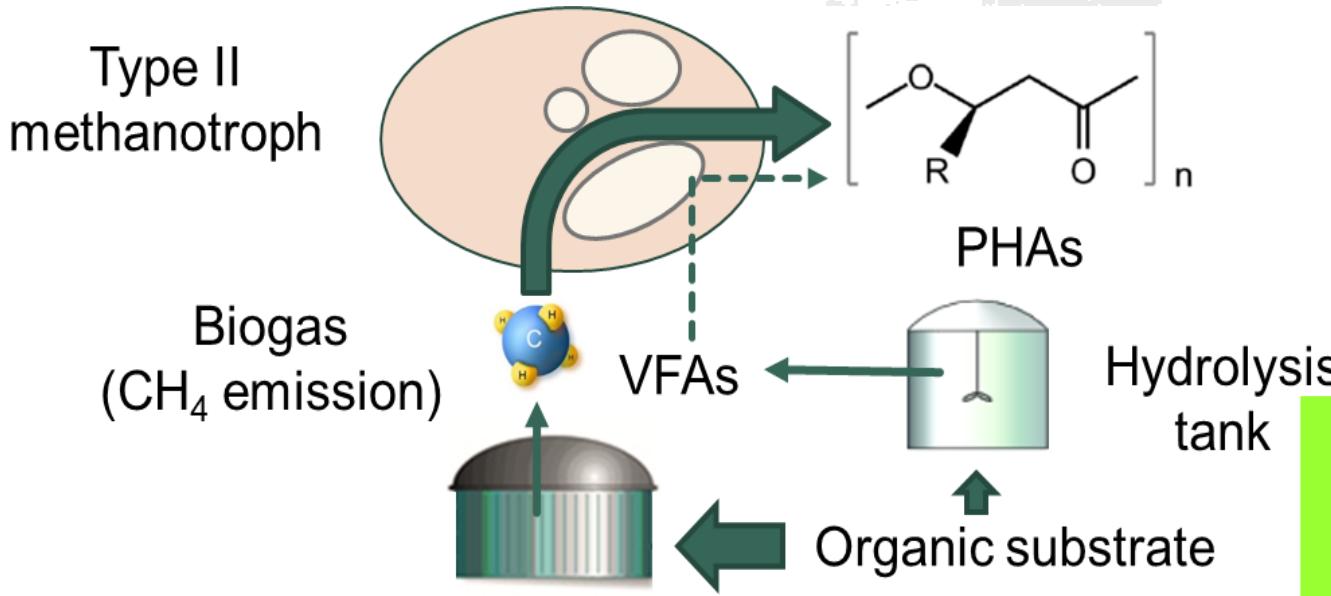
BIOGAS FERMENTER (PHA)



- Based on the action of lithoautotrophs:
H₂S as energy source & CO₂ carbon source
- e- acceptor: NO₃⁻
- No significant CO₂ associated
- EBRT: 2-16 min (H₂S-RE: 99%)

Module III. Biogas bioconversion to biomethane and added value products

Explore the potential of biogas bioconversion into biopolymers



Contents lists available at ScienceDirect

Chemical Engineering Journal

journal homepage: www.elsevier.com/locate/cej



Biogas-based polyhydroxyalkanoates production by *Methylocystis hirsuta*: A step further in anaerobic digestion biorefineries



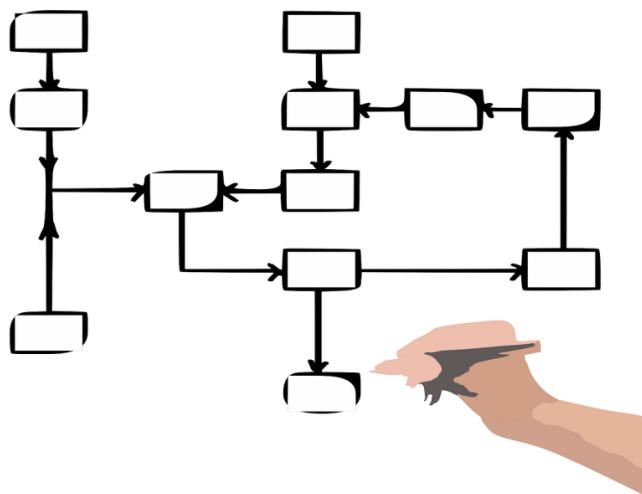
Juan C. López, Esther Arnáiz, Laura Merchán, Raquel Lebrero, Raúl Muñoz*

Department of Chemical Engineering and Environmental Technology, School of Industrial Engineering, University of Valladolid, C/Dr. Mergelina s/n, 47011 Valladolid, Spain

Culture condition	PHA		
	PHA content (wt %)	HB fraction (mol %)	HV fraction (mol %)
Biogas	43.1 ± 1.8	100	0
Biogas + Acetic acid	52.3 ± 0.7	100	0
Biogas + Propionic acid	47.9 ± 0.7	98	2
Biogas + Butyric acid	52.2 ± 2.1	100	0
Biogas + Valeric acid	53.8 ± 0.8	75	25

Project plan

Process definition and pilot plant construction



2017-2018

Demo activity



2019-2020

✓ Final products requirements



2020-2021

THANK YOU FOR YOUR ATTENTION



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