



*Innovative fully biodegradable mulching films & fruit protection bags for sustainable agricultural practices LIFE14 ENV/ES/00048*

LIFE MULTIBIOSOL



***AGRIMAX*** Agri & food waste valorisation co-ops based on flexible multi-feedstocks biorefinery processing technologies for new high added value applications

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# 1.3 billion ton of food is globally wasted per year

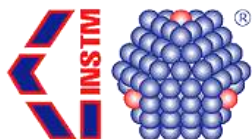
**32%**

of the food  
produced is  
wasted

**16%** of food waste is generated at **field and processing level**

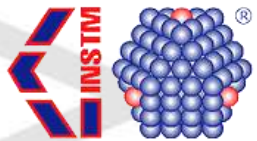


**700 million tons** of agricultural  
waste are generated in EU annually



# Possible valorisation

Value



# INSTM (UNIFI) and IRIS were partners in:



**BIOBOARD** Development of sustainable protein-based paper and paperboard coating systems to increase the recyclability of food and beverage packaging materials **Research for the benefit of SME AGs, 01.11.2012-31.10.2015**



E. Bugnicourt, M. Schmid, O. Mc. Nerney, J. Wildner, L. Smykala, A. Lazzeri, and P. Cinelli «Processing and validation of whey protein coated films and laminates at semi-industrial scale as novel recyclable food packaging materials with excellent barrier properties», *Advances in Materials Science and Engineering*, Volume 2013, Article ID 496207.

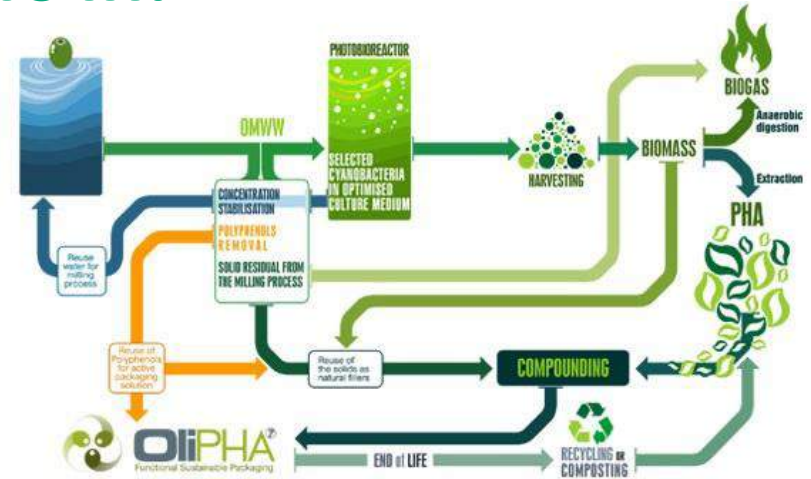
P. Cinelli, M. Schmid, E. Bugnicourt, J. Wildner, A. Bazzichi, I. Anguillesi, A. Lazzeri "Whey protein layer applied on biodegradable packaging film to improve barrier properties while maintaining biodegradability", *Polymer Degradation and Stability*, 2014, 108, 151-157.



# INSTM and IRIS were partners in:



# OLiPHA<sup>®</sup>



**OLIPHA** “A novel and efficient method for the production of polyhydroxyalkanoate polymer-based packaging from olive oil waste water”  
*NMP2011.Small* , 01.06.2012-31.05.2015

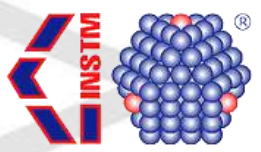
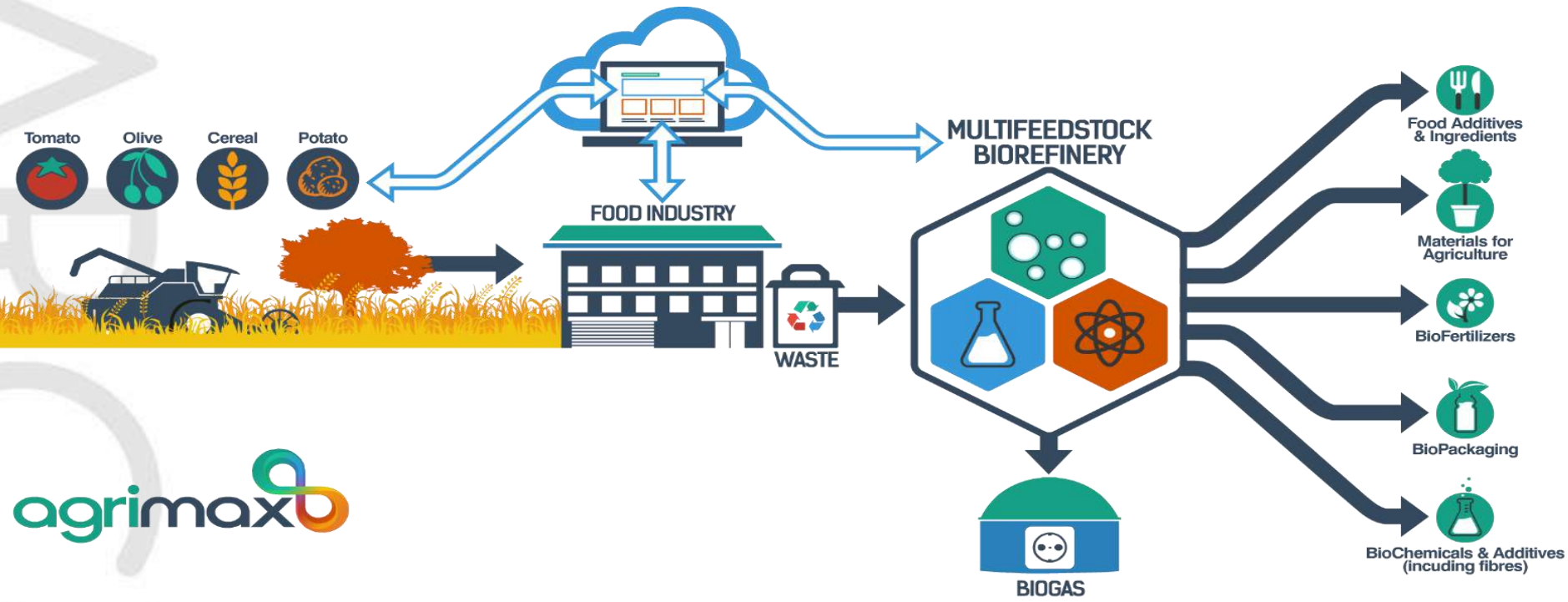
## Collaborative Project

Small or medium-scale focussed research projects - Specific International Cooperation Actions (SICA) to promote the participation of emerging economies and developing countries: Latin America.

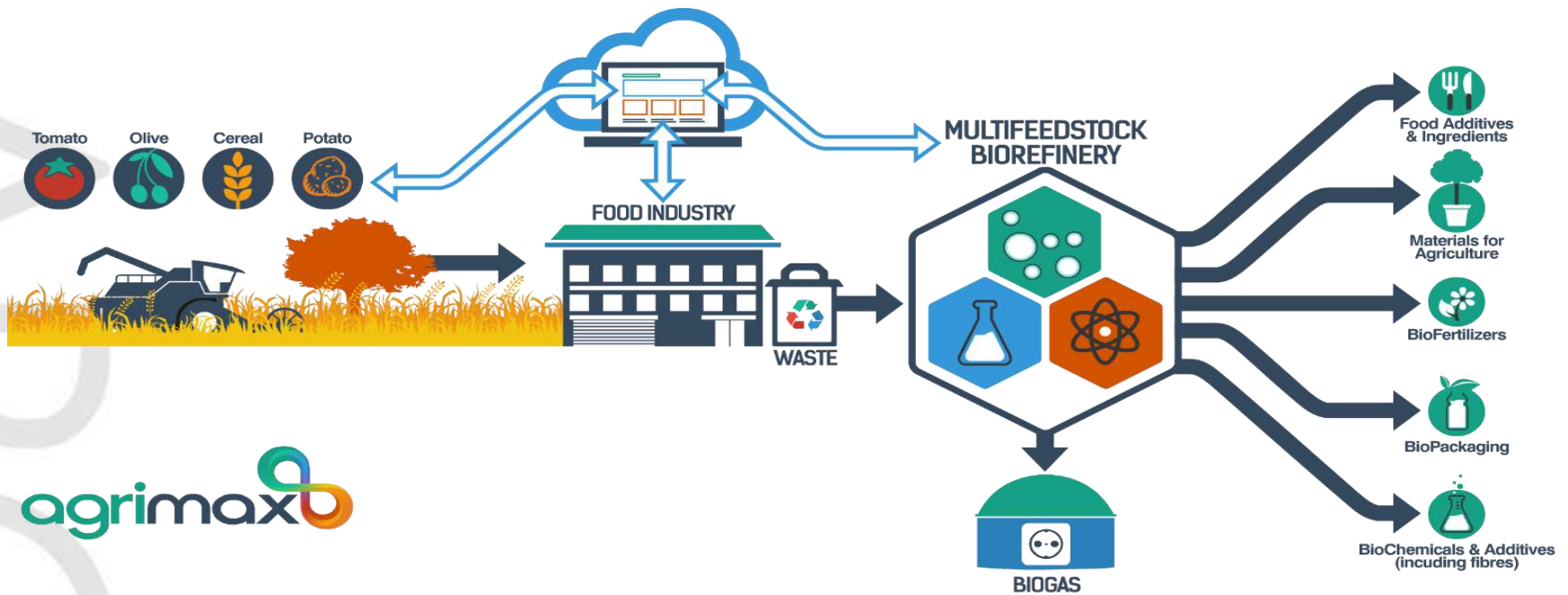
## Research Activity:

Characterization of the PHAs produced. Blends with PHAs and plasticizers, production of composites and nano composites.









- To demonstrate the **technical and economic feasibility of combined flexible biorefinery processes** for valorising crops & food processing wastes.
- To maximise the economic and environmental sustainability of the EU **agricultural and food sectors** while providing new **biocompounds** to the **chemical, food, packaging and agriculture sectors**

# AgriMax in numbers

48 Months

29 Partners

11 Countries (Austria, Belgium, Germany, Hungary, Ireland, Italy, the Netherlands, Norway, Slovenia, Spain, United Kingdom)

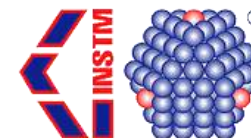
15 Million € (ca. 12 M€ EC contribution)

TRL >7 Demonstration Action

BBI VC3.D5 - 2015 Valorisation of agricultural residues and side streams from the agro-food industry

List of Participants

Participant no.	Participant name	Participant short name	Country	type
1 (CO)	Innovacio i Recerca Industrial i Sostenible SL	IRIS	Spain	SME
2	Asociación de Investigación de Materiales Plásticos y Conexas	AIMPLAS	Spain	RTD- associated BBI member
3	Universiteit Gent	UGENT	Belgium	RTD- associated BBI member
4	Consorzio Inter Universitario Scienza e Tecnologia dei Materiali	INSTM	Italy	RTD- associated BBI member
5	Institut de Recerca i Tecnologia Agroalimentaries	IRTA	Spain	RTD- associated BBI member
6	Nofima AS	NOFIMA	Norway	RTD- associated BBI member
7	Instituto Tecnológico del Embalaje, Transporte y Logística	ITENE	Spain	RTD- associated BBI member
8	Università di Bologna	UNIBO	Italy	RTD- associated BBI member
9	Fraunhofer - Gesellschaft	FRAUNHOFER	Germany	RTD
10	Stazione Sperimentale per l'Industria delle Conserve Alimentari	SSICA	Italy	RTD
11	University College Dublin	UCD	Ireland	RTD
12	Universidad de Almería	UAL	Spain	RTD- associated BBI member
13	Biovale Ltd	BIOVALE	UK	SME (cluster)- BBI member
14	Federació de Cooperatives Agràries de Catalunya	FCAC	Spain	SME (federation)
15	Food Industry Federation Austria	FIAA	Austria	SME (federation)
16	Gospodarsko Interesno Združenje Grozd Plastehnika	PCS	Slovenia	SME (cluster)
17	Chiesa Virginio	CHIESA	Italy	SME
18	Exergy Ltd	EXERGY	UK	SME
19	Laboratori ARCHA s.r.l.	ARCHA	Italy	SME
20	Femto Engineering SRL	FEMTO	Italy	SME
21	Laser Consult Ltd.	LC	Hungary	SME
22	Mycoplast di Federico Maria Grati e Stefano Babbini S.n.c.	MYCOPLAST	Italy	SME
23	Organic Waste Systems NV	OWS	Belgium	SME
24	Bioprocess Pilot Facility B.V.	BPF	NL	Large- BBI member
25	Fertinagro Nutrientes, S.L.	FERTINAGRO	Spain	Large- BBI member
26	Ginegar Ltd.	GINEGAR	Israel	Large
27	Barilla G.E.R. Fratelli SPA	BARILLA	Italy	Large
28	Induleida SA	IL	Spain	Large
29	Ardagh Group Italy Srl	ARDAGH	Italy	Large



Multibiosol Workshop, Pisa, 23<sup>rd</sup> November 2017

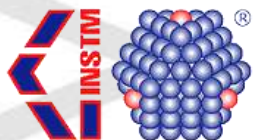
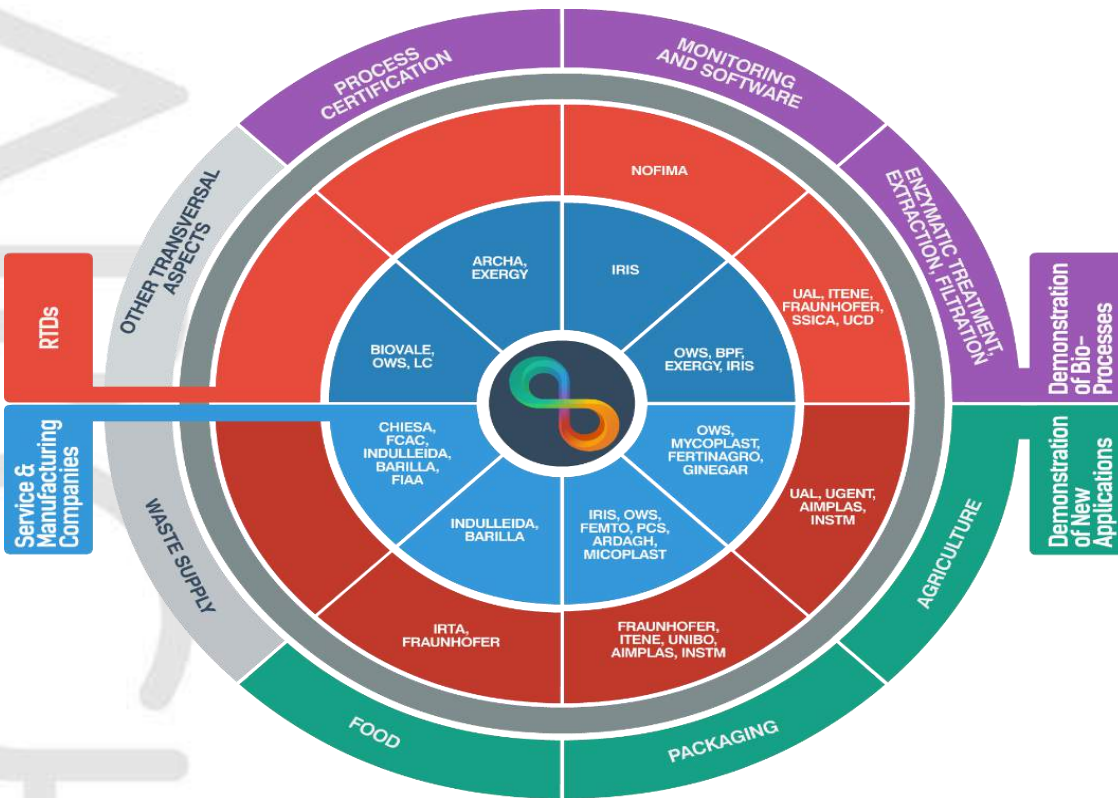




The whole supply and value chain is covered thanks to:

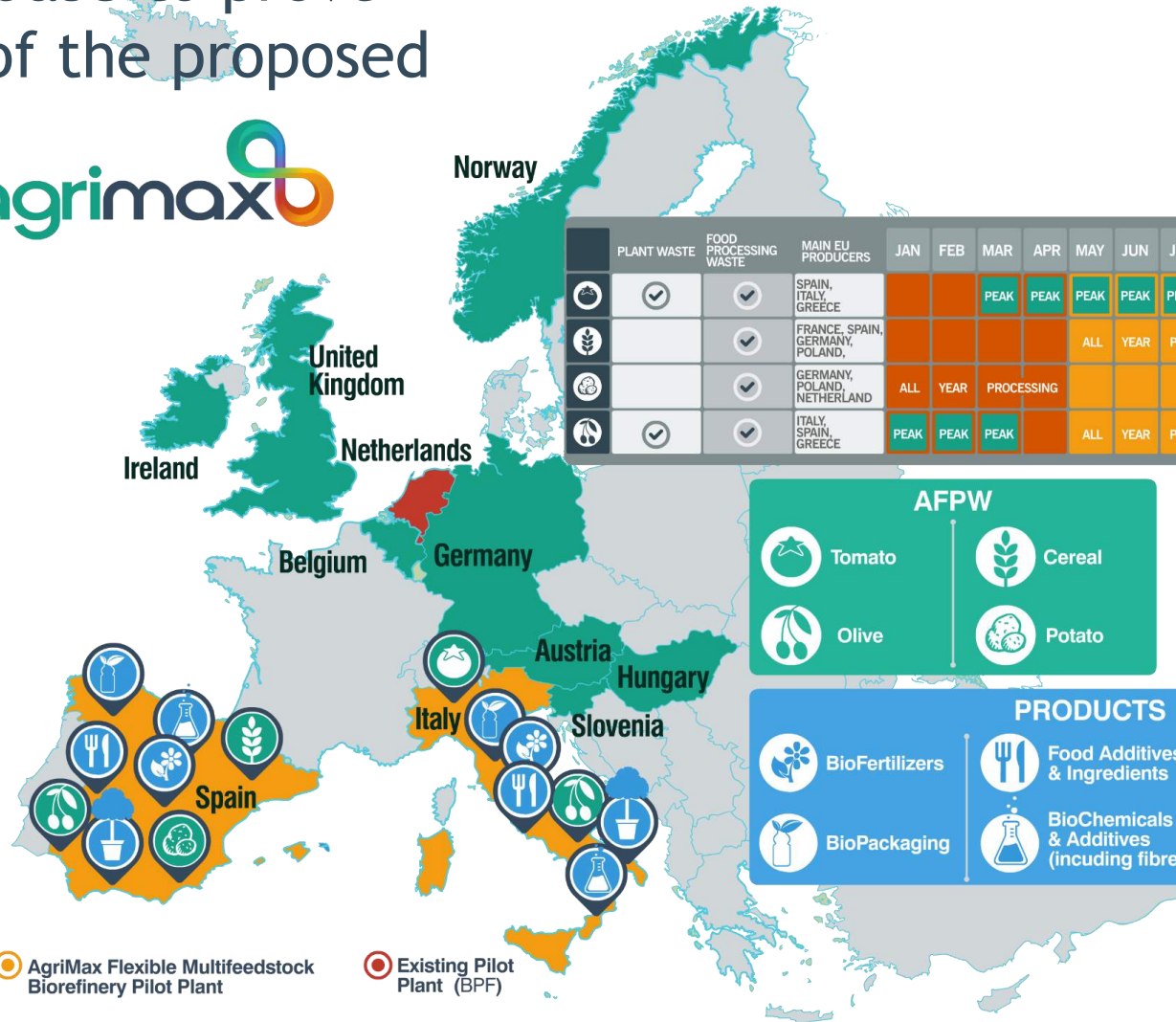
- **11 RTDs**
- **18 industrial partners** (12 SMEs and 6 large enterprises) of which 5 are multipliers

3 partners are **BIC** members and 8 associated **BIC** members to maximise the alignment with the BBI programme

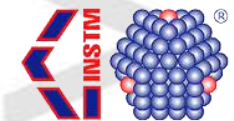


Two pilot plants are going to be designed and will run on a **cooperative base** to prove the viability of the proposed approach

# Two case studies



	PLANT WASTE	FOOD PROCESSING WASTE	MAIN EU PRODUCERS	JAN	FEB	MAR	APR	MAY	JUN	JUL	AGO	SEP	OCT	NOV	DEC
	✓	✓	SPAIN, ITALY, GREECE			PEAK	PEAK	PEAK	PEAK	PEAK	PEAK	PEAK	ALL YEAR PROCESSING		
		✓	FRANCE, SPAIN, GERMANY, POLAND,					ALL	YEAR	PROCESSING					
		✓	GERMANY, POLAND, NETHERLAND	ALL	YEAR	PROCESSING					PEAK	PEAK	PEAK	PEAK	PEAK
	✓	✓	ITALY, SPAIN, GREECE	PEAK	PEAK	PEAK		ALL	YEAR	PROCESSING			PEAK	PEAK	PEAK



AgriMax Flexible Multifeedstock Biorefinery Pilot Plant

Existing Pilot Plant (BPF)



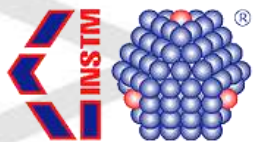
# The project Steps

Design of the cascading approach

Conversion of the raw material

Validation of the products

Elaboration of the business strategy



# The processing technologies

**Thermal Treatment** to prepare the biomass for the cascading processes

**Enzymatic Treatment** to upgrade the biomass or prepare the biomass for the cascading processes

**Ultrasound Extraction** to recover target compounds and prepare further steps

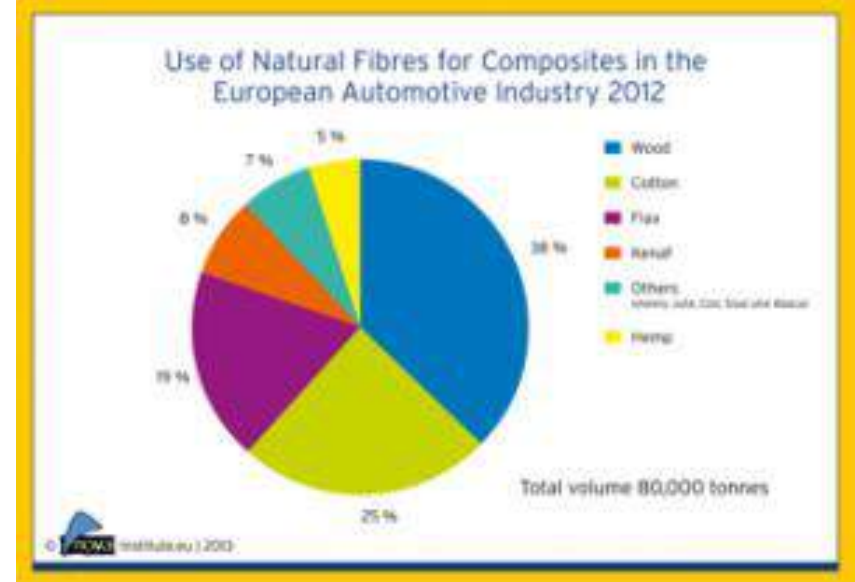
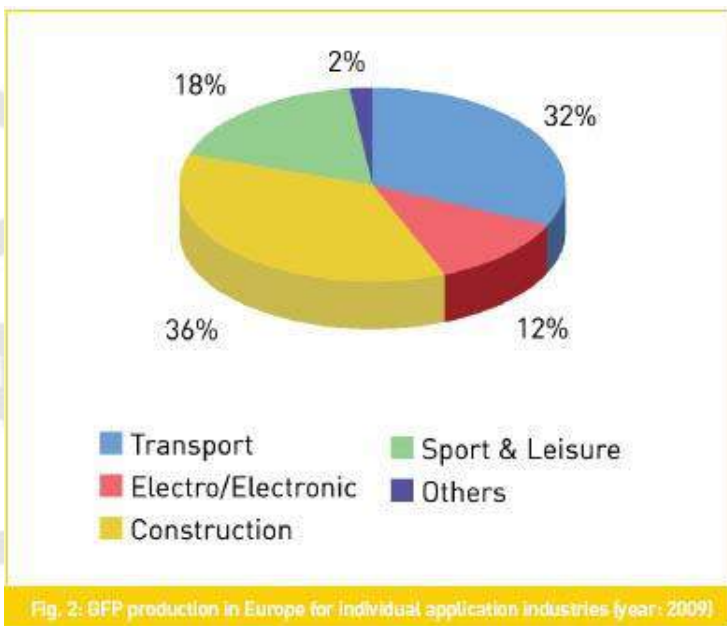
**Solvent Extraction** to recover target compounds and fractionate the biomass

**Sedimentation & Precipitation** to recover target compounds and fractionate the biomass

**Filtration & Centrifugation** to recover target compounds and fractionate the biomass







Source: TOP Biocomposites: 350,000 t production of wood and natural fibre composites in the European Union in 2012.  
<http://news.bio-based.eu/biocomposites/>





# Industrial scale processing



Processing with the Industrial COMAC co-rotating twin screw extruder EBC 25HT  
Processing was performed at 8Kg/ hour, motor speed 2.70 rpm, processing temperature between 160-170 °C, screw speed 350 rpm.



# The final Products

## Safe and environmentally friendly Bio-Packaging

(bioplastic flexible and rigid packaging, active and barrier packaging, biobased coatings for metal packaging, biocomposites, as well as secondary packaging).

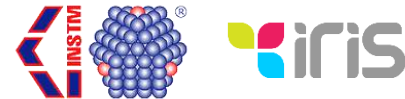


## Healthier and functional Food products

(additives, ingredients, coatings, microorganisms used in production, enhanced food products)

## Bio-based Agriculture products

(bioplastics embedding fertilisers based solutions for biodegradable mulching films and pots as well as biofertilisers with biostimulant and biocontrol properties)



# The expected Impact

Demonstrate **new value chains** for **higher added value products** and **open new markets**

Improve the **environmental performance and cost efficiency** of the biorefinering process as compared to the current state of the art

Demonstrate an integrated process with **more than 40% of the raw material valorised** into high added value products

Validate new products with a **2-5 times higher value** than the current applications of the raw material, leading to a significantly higher total valorisation of the agricultural crops so contributing to **rural development and employment**





# Thanks for your attention!



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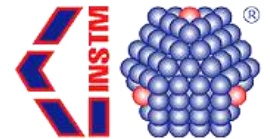
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Bio-based Industries  
Consortium  
Multibiosol Workshop, Pisa, 23<sup>rd</sup> November 2017



# BIOPLASTICTRAIN project

will develop **innovative e-learning training contents for plastic processing and finishing technicians on the use of bioplastic and biopolymers.**

This training contents will be based exclusively on the vast know-how from successful European research and development funded project.

<b>Definition and Characteristics</b>	<b>(University of Pisa, Italy)</b>
<b>Extrusion Compounding</b>	<b>(Tecnopackaging, Zaragoza, Spain)</b>
<b>Injection Moulding</b>	<b>(Tecos, Celje, Slovenia)</b>
<b>Blow Moulding</b>	<b>(Aitiip, Zaragoza, Spain)</b>
<b>Biocoating</b>	<b>(Fraunhofer, Wursburg, Germany)</b>