Bioeconomy: a tool for improving efficiency in the food industry

Dr Manuel Lainez
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Láinez Biotrends
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1. Why and how we have promoted bioeconomy in Spain
2. Bioeconomy and legislative framework
3. The tecnologies behind wastes processing
4. Oportunities for the bioeconomy

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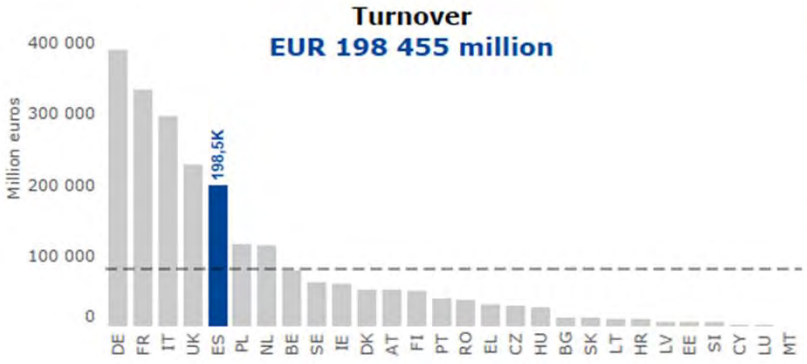
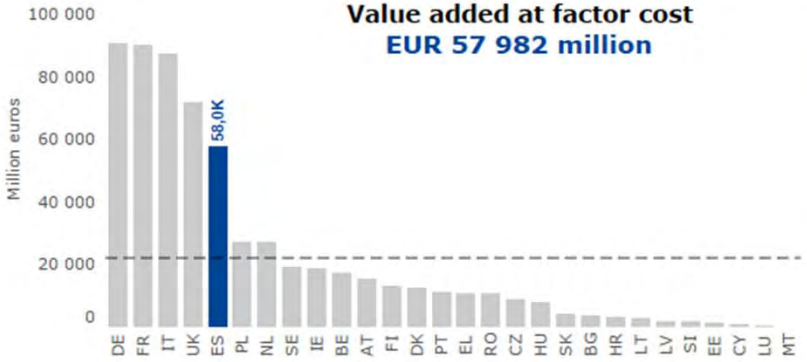
Year	Bio-based activities
2015	Todo



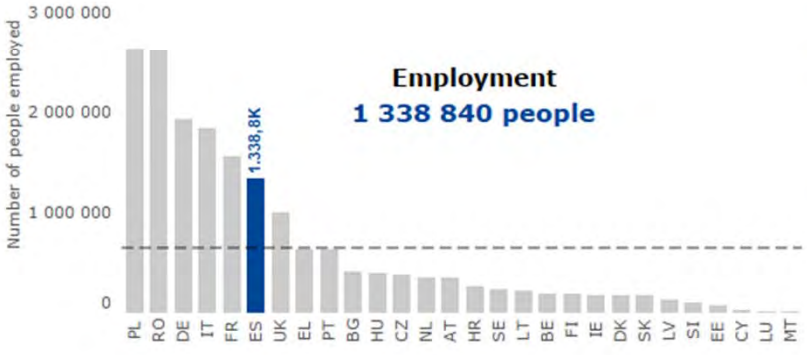
Turnover in Spain in Agriculture, Bio-based chemicals, pharmaceuticals, plastics and rubber (excl. biofuels), Bio-based electricity y 7 más sector(s) in 2015

The turnover is used as a market size indicator in the EU bioeconomy strategy. The turnover of a given sector represents the value of sales from this sector. The turnover of the whole bioeconomy includes all the sales from the different activity sectors that compose the bioeconomy, including the sales of products from one sector to a downstream sector of the bioeconomy. It thus leads to occasional double counting throughout the value chain.



Value added in Spain in Agriculture, Bio-based chemicals, pharmaceuticals, plastics and rubber (excl. biofuels), Bio-based electricity y 7 más sector(s) in 2015

The value added (factor costs) is the gross income from operating activities after adjusting for operating subsidies and indirect taxes. Value adjustments (such as depreciation) are not subtracted.



Employment in Spain in Agriculture, Bio-based chemicals, pharmaceuticals, plastics and rubber (excl. biofuels), Bio-based electricity y 7 más sector(s) in 2015

Number of persons employed by country, year and sector of the bioeconomy

JRC, 2.018

Estimated: 6,5% GDP and 9% working population

Agrifood Sector
5,59% GDP (2015)

- 2,42 % GDP primary production:: 890.000 farms
- 0,20 % GDP Fisheries: 5.025 operations
- 2,97 % GDP, food processing industry: 28.800 companies

17% of Spanish sales abroad

Forestry Sector
0,60% GDP (2015)

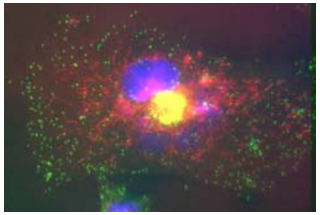
- 0,18 % GDP timber and cork
- 0,34 % GDP paper
- 0,08 % GDP other

Biomass for energy
0,34% GDP (APPA2015)

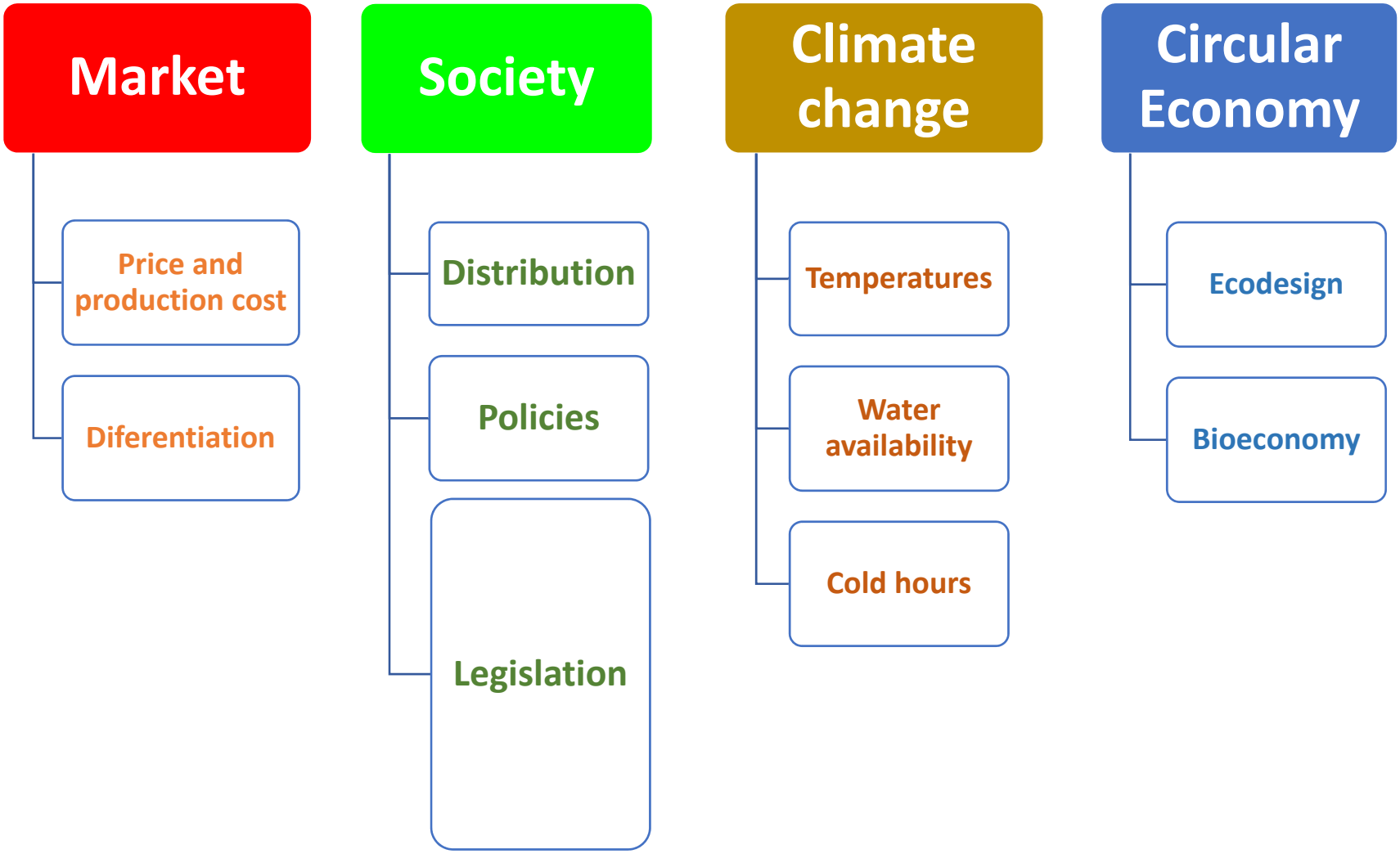
- 176 biomass companies for energy and other purposes
- 47 Companies devoted to biotech

Non-health biotechnology sector:((INE, 2015)

2.831 companies



Food value chain challenges



Research in Bioeconomy

World position in:

*** Agr. & Biol Sciences: 7º**

*** Environm Sciences: 8º**

*** Biotech & Biochem: 9º**

2.780 research projects in 2015

Articles in journals (2015)

*** 8.786 in Agr. & Biol Sc**

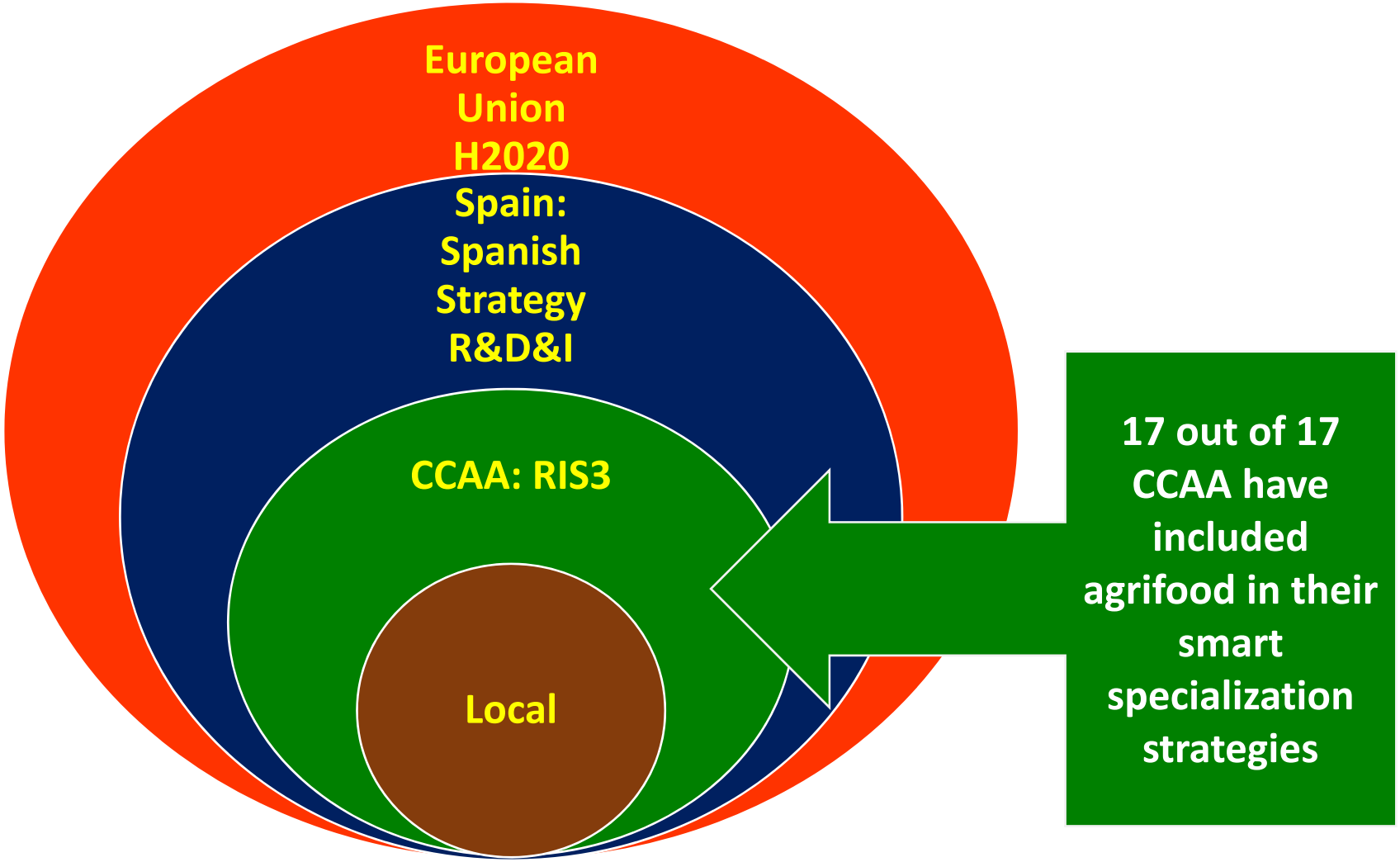
*** 5.162 in Environm Sc**

*** 3.499 in Biotech & Bioch**

Innovation

22% of the agrifood companies invested in innovation in 2014

Great colaboration between companies, universities and OPIs


European Union H2020
Spain: Spanish Strategy R&D&I
CCAA: RIS3
Local
17 out of 17 CCAA have included agrifood in their smart specialization strategies

Scen 2009)

“business as usu l contribute up to
app 2030.

Trough hening

Estrategia española
de Bioeconomía
Horizonte 2030

¿How to promote the bioeconomy?: the strategic lines

- To promote public and private research and company investment in innovation in the area of the bioeconomy
- To reinforce the social, political and administrative context of the bioeconomy.
- To promote the competitiveness and development of the market associated with the bioeconomy.
- To develop demand for new products

Plan to expand and promote the bioeconomy

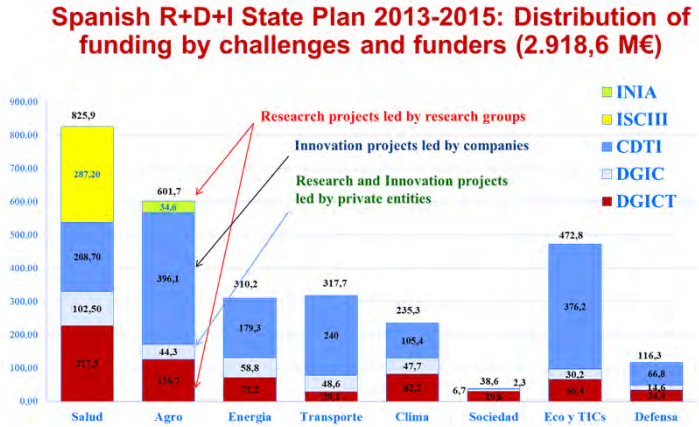
1. To promote public and private research and company investment in innovation in the area of the bioeconomy.

- **To fund research projects through the related calls by the bodies authorized.**

Challenge 2. State Plan R+D+I: BIOECONOMY: Primary and Forestry production systems Sustainability; Food security and quality; Marine and Maritime Research; and Bioproducts in circular economy

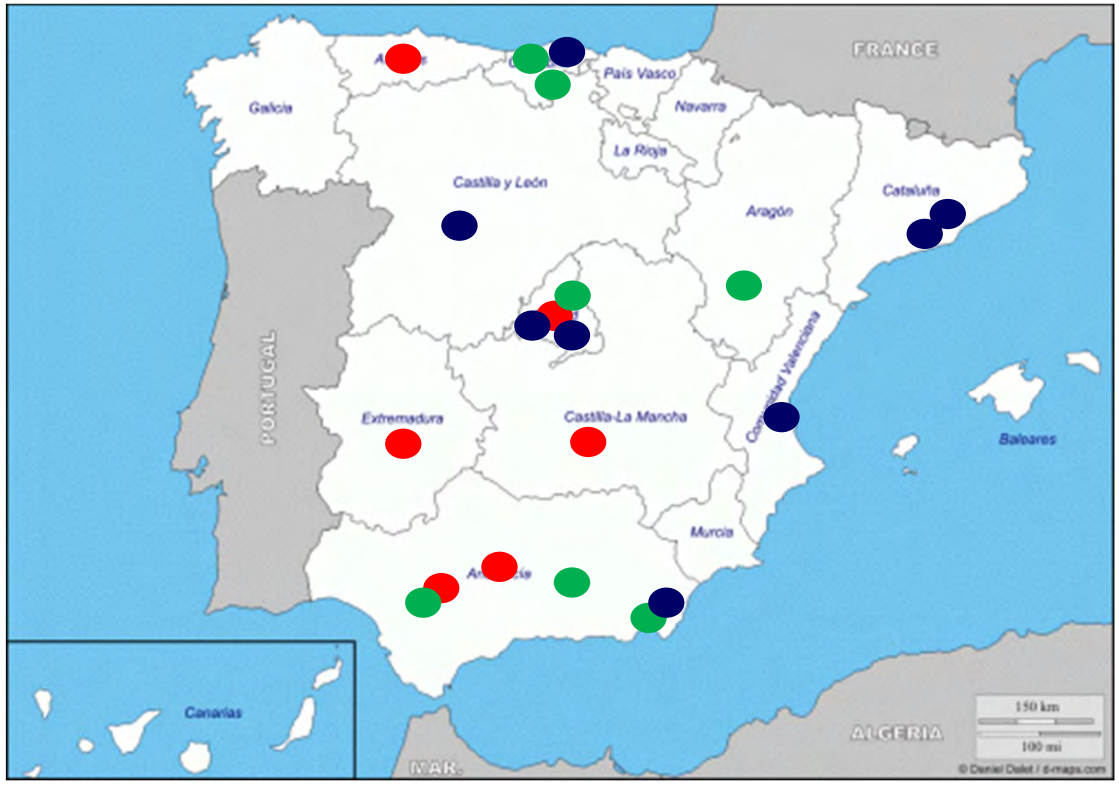
Different Funding Calls

- Research calls
- Private – public collaboration calls
- Innovation calls



1. To promote public and private research and company investment in innovation in the area of the bioeconomy.

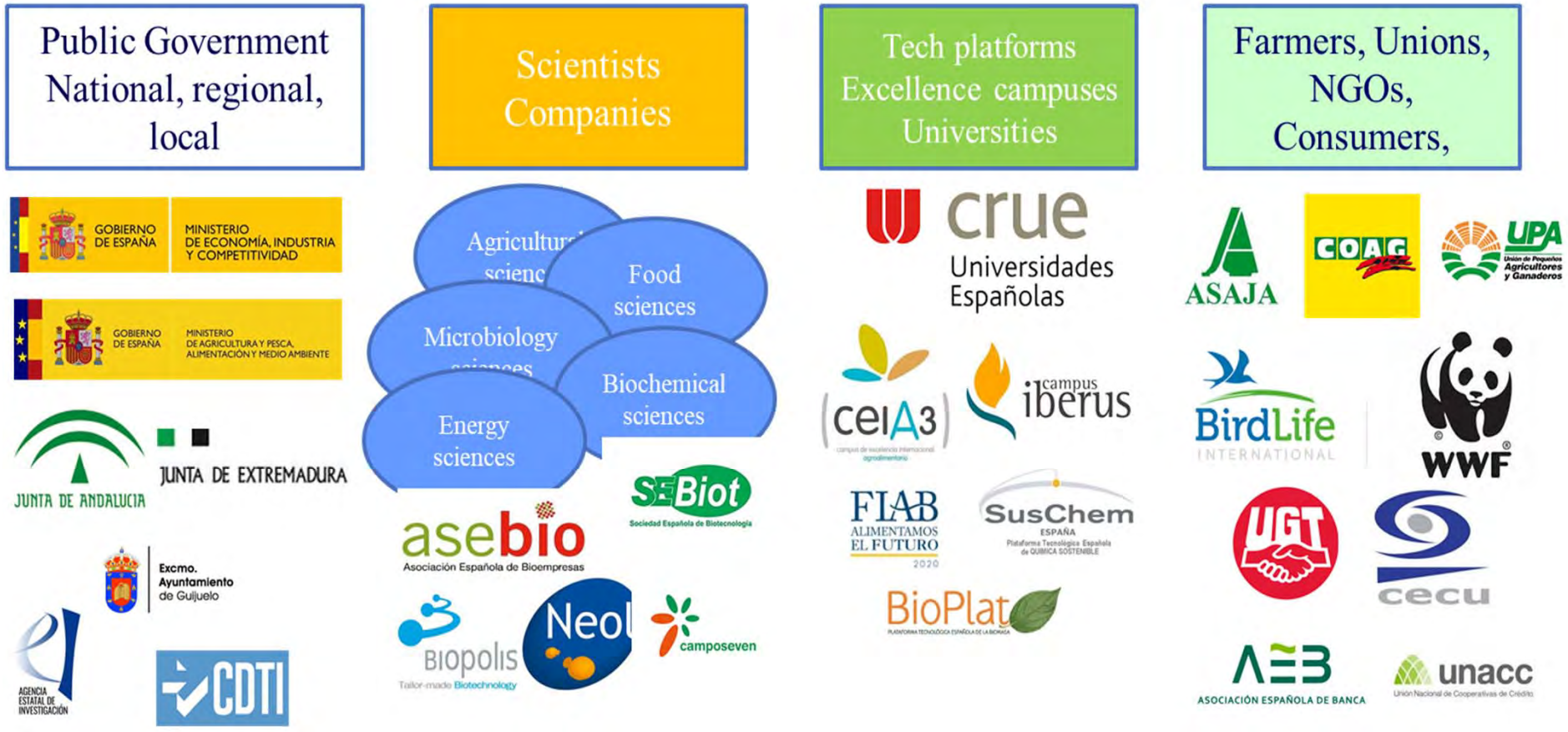
- **Coordinated program of seminars, forums and meetings: 2016 - 2018**
  - ❑ CONAMA Sessions: Bioeconomy as a tool for circular economy



- Central / Regional Governments
- Universities: summer courses
- Private institutions

2. To strengthen the bioeconomy's social, political and administrative frame of reference.

- **The Spanish Bioeconomy Observatory**



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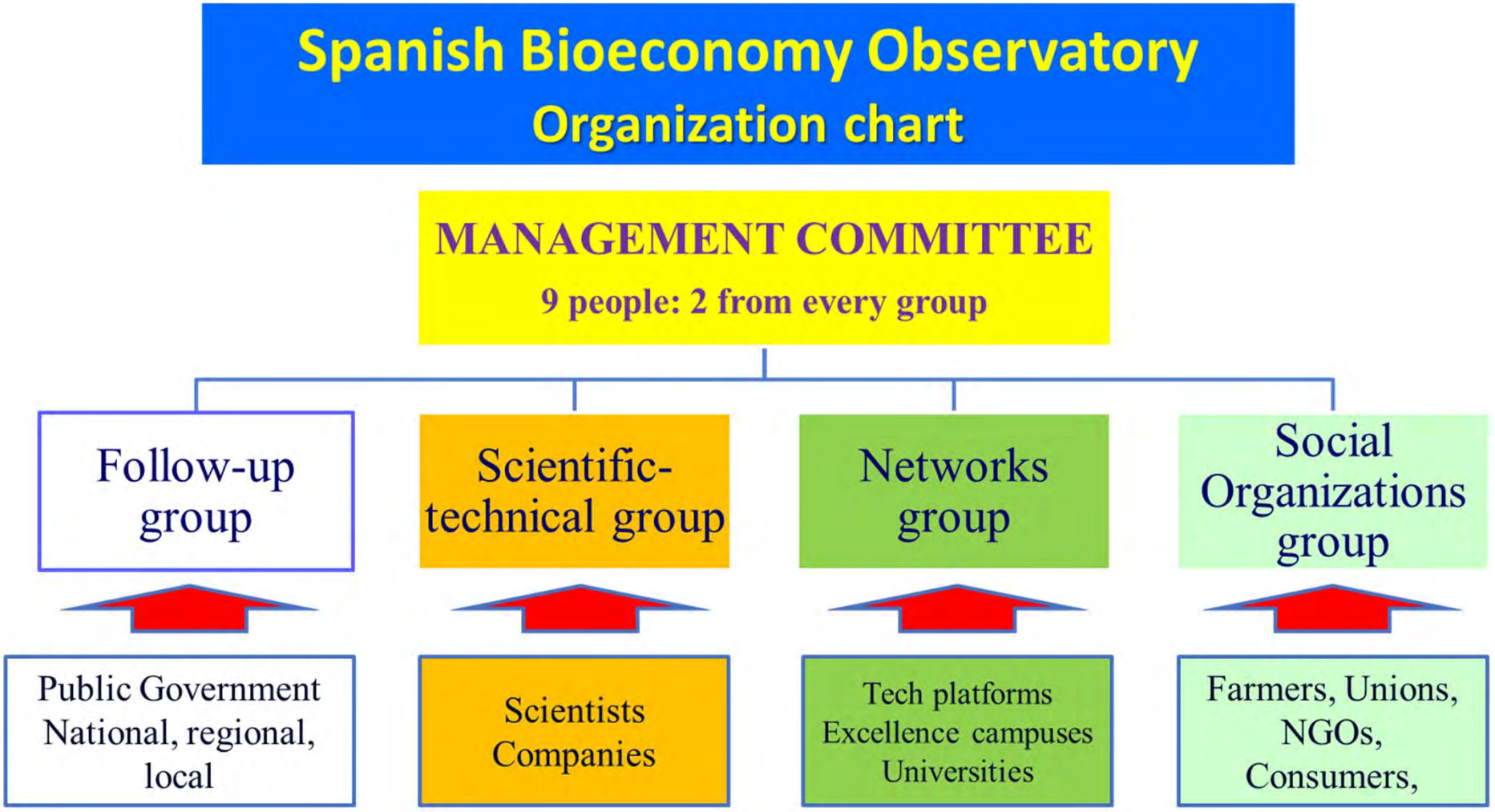

3. In the field of competitiveness and market development

- **Compiling the environmental footprints of products**

Two especial meetings devoted to Sustainability Indicators in primary production sectors

- **Forestry sector: 14/07/2016**
- **Agriculture: 28/11/2017**

PRESENTATION OF RESEARCH AND INOVATION PROJECTS

5. Plan for the expansion of the Bioeconomy

- **To promote bioeconomy strategies in autonomous regions: so far 9 autonomous regions out of 17 are working on that**

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European Commission

CIRCULAR ECONOMY

Closing the loop

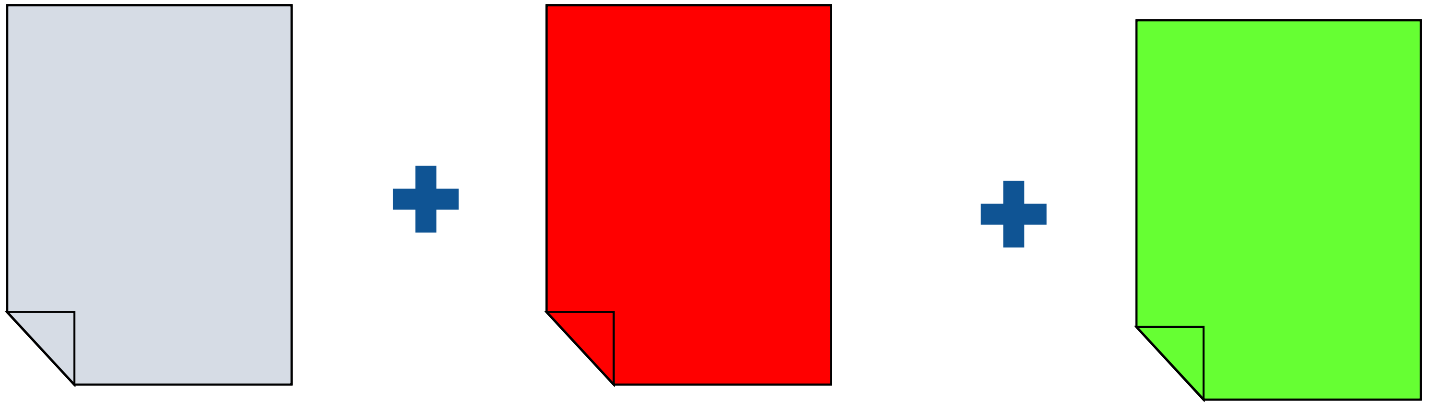
AN AMBITIOUS EU CIRCULAR ECONOMY PACKAGE

EU Circular Economy

Circular Economy Package

Adopted December 2015

Updated July 2018



Action Plan

Anex
54 Measures

Legislative proposals
wastes

EU Circular Economy

Circular Economy Package

Priority flows

- Plastics
- Food wastes
- Critical raw materials
- Building and demolition
- Biomass and biomass based products

EU Circular Economy. Circular Economy Package

Updated July 2018

Key elements of the revised waste proposal

A common EU target for recycling 65% of municipal waste by 2035

A common EU target for **recycling 70% of packaging waste by 2030;** There are also **recycling targets** for specific packaging materials:

- **Paper and cardboard: 85 %**
- **Glass: 75 %**
- **Plastic: 55 %**

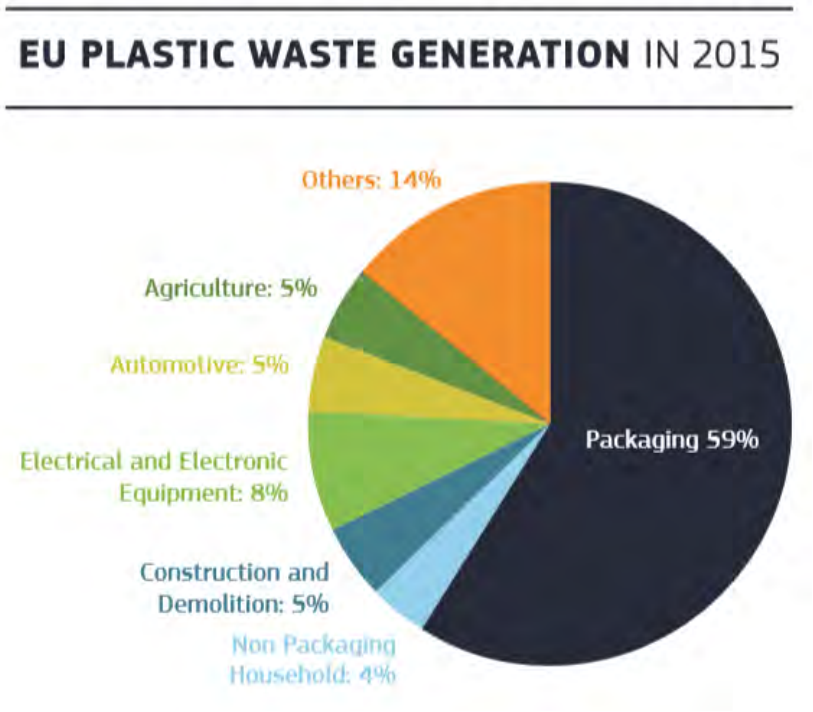
Separate collection obligations are strengthened and extended to:

- hazardous household waste (by end 2022)
- **bio-waste (by end 2023)**
- textiles (by end 2025).

Prevention objectives are significantly reinforced, in particular, requiring Member States to take specific measures to tackle food waste and marine litter as a contribution to achieve EU commitments to the UN SDGs.

EU Circular Economy

Circular Economy Package: plastics



25,8 M TM / year: 30 % is recycled

between 1,5 – 4 % world produced plastics end in the oceans

Between 75.000 – 300.000 Tm microplastics are released in the EU environment

Strategy

By 2030, all packaging plastics entering the EU Market must be:

- **Reusable**
- **Recyclable at effective cost / effectiveness**

This means:

- **Improve design and innovation to facilitate recycling: biodegradable?**
- **Improve recycling conditions**
- **Create market conditions for products from recycling and renewable plastics**

Traditional value chains: strengthening

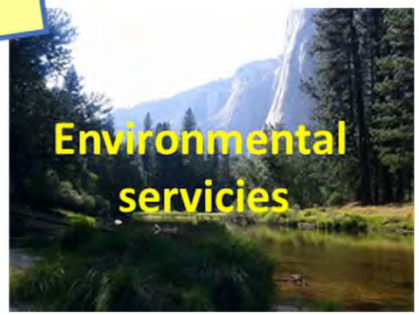
Traditional value chains: strengthening

FOREST Value Chain

FORESTRY

WOOD
Efficiency

Sustainable management



Building materials

Textiles

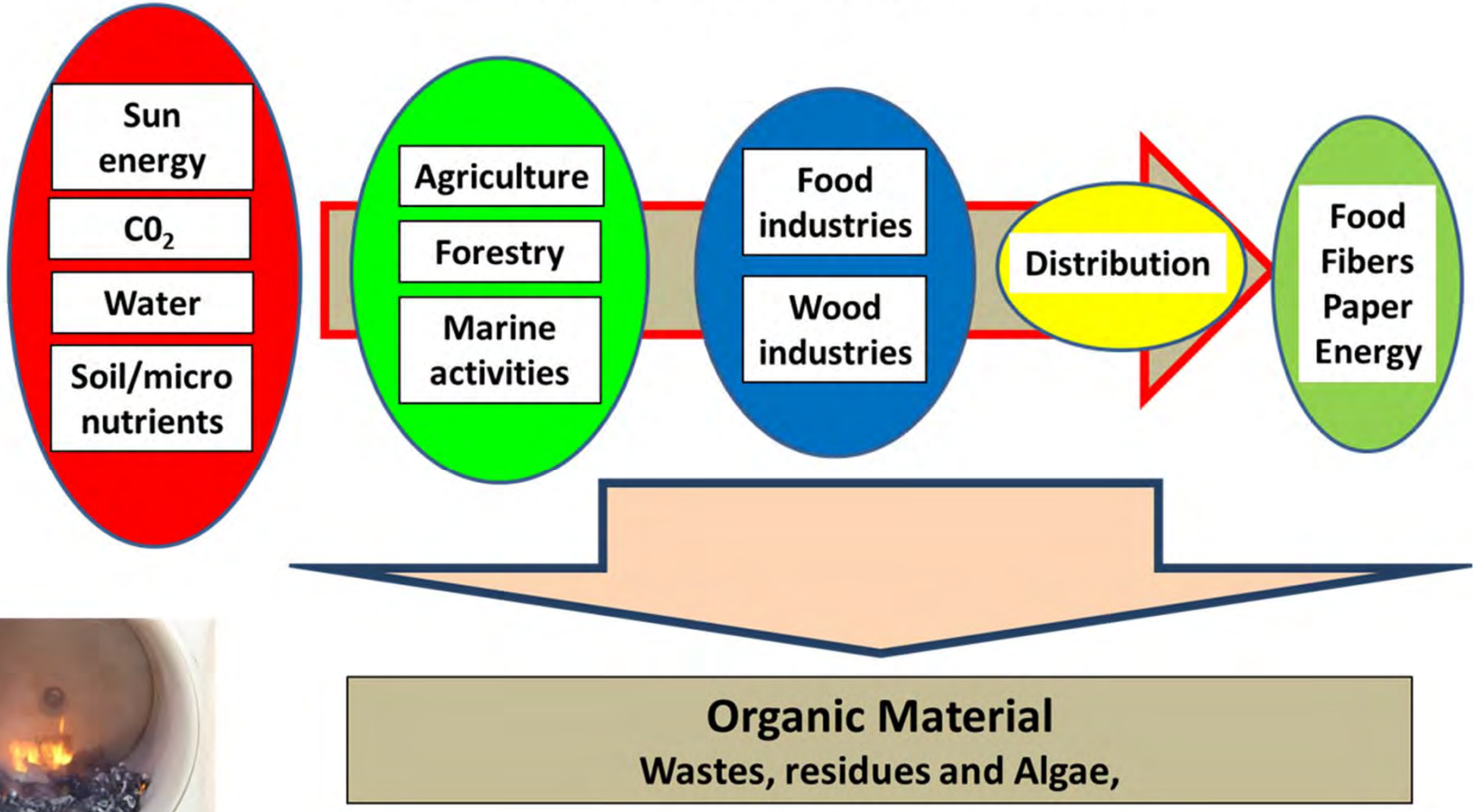
Paper

Biomass: bioproducts

Heat / Energy

Non food biomass available in Spain
Water scarcity

Residues from food / wood chain



What type of biomass can be produced in Spain?
Water scarcity

Estimated Wastes and Residues in Spain

(PER 2020, 2011, Probiogas 2010)

	M t/y
• **Biomass**	
• Forestry residues	18
• Arable and permanent (trees) crop residues	30
• such as straw or husks, grass silage,	
• brash and arboricultural arising	
• Agro food wastes	31
• Inedible components: peel, skin, husks, cores, fish heads, pulps	
• Organic material from excess production or insufficient market	
• Wasted materials from food and drinks: wine, beer, cheese,	
• Food preparation: fat, cooking oils, food disposed of for safety reasons	
• Woody wastes, paper pulp, textiles, etc	6
• **Animal residues**	48
• Manures and slurries	
• Animal bedding such as poultry litter	
• **MSW (municipal solid waste) and Sewage sludge**	26
	159

Estimated Availability

60%

collected and stored

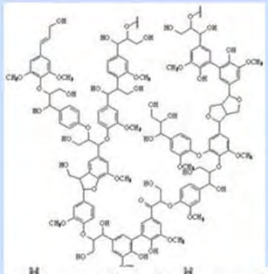
96 M t/y

New value chains: creation

RESIDUAL BIOMASS TRANSFORMATION

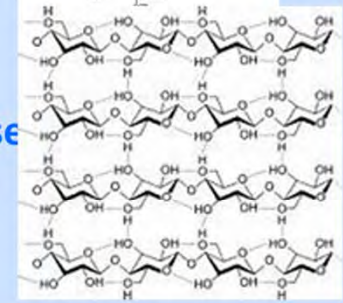
BIOMAS
Biological byproducts

lignin

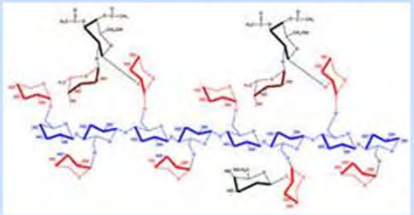


Cellulose

Hemicellulose



Proteins



Food products:

Feed products

Biomaterials:: composites, binders,phenols

Bioproducts: sugars and biomterials,

Biofuels

Energy

CASCADING USE BIOMASS

New value chains: creation

BIOMAS
Yellow (straw, wood, paper pulp)

pretreatment

Enzimatic treatment

Microorganism cultivated on sugars

Bioethanol

Biochemicals

bioplastics

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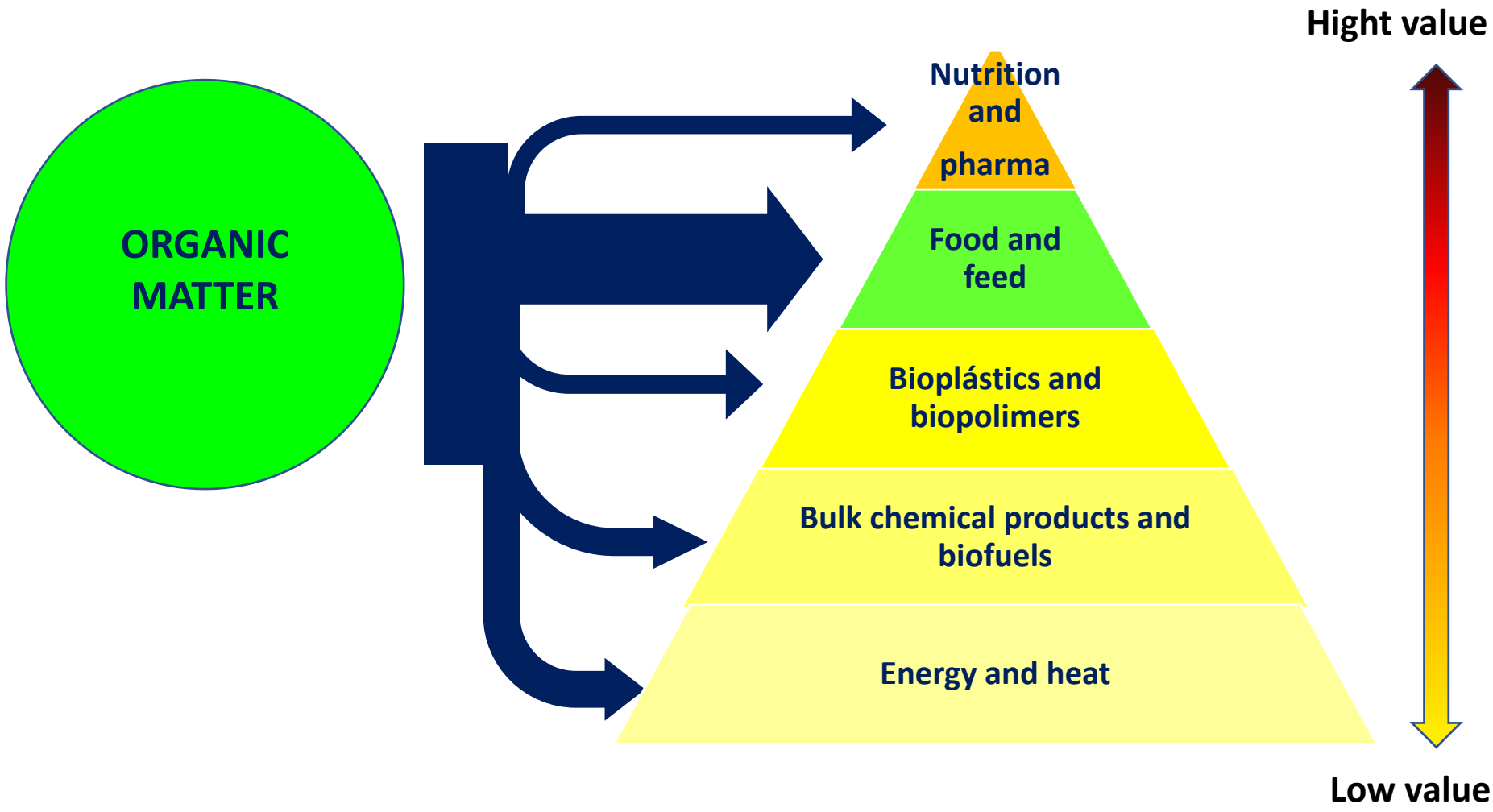
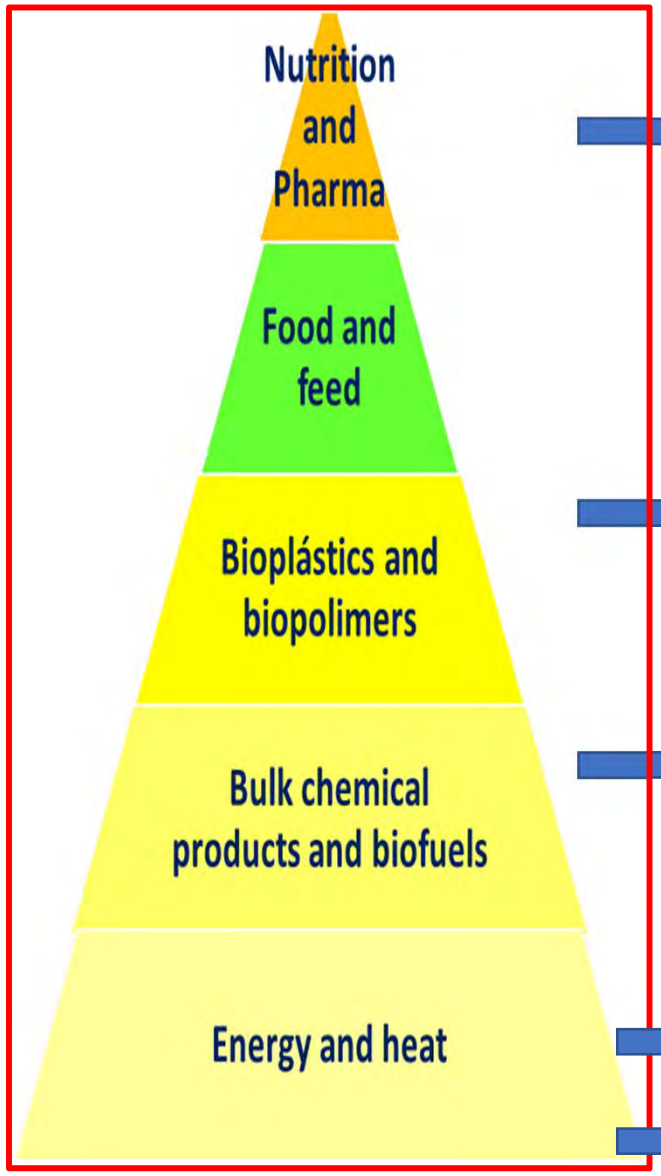
Bioeconomy: economical activity conducted to obtain market products based on biological raw materials



BIOECONOMY PRODUCTS: THE IMPORTANCE OF TECHNOLOGIES



Active Components Extraction:

- Distilation: maceration, percolation, infusion, extraction with cold or hot oil or with green solvents
- Supercritical fluids or subcritical water
- Negative pressure cavitation

Enzimatic Processes:

- Enzimatic proces
- biocatalysis

Microorganisims fermentation: solid or liquid:

- Enzimes: amilolitics, lignolceluli, pectinolitics
- Organic acids: lactic, citric
- Biofuels: ethanol
- Biopolimers: special rubber
- Bulk chemicals: succinic acid, PHA
- Biogas: methane, bioethanol, bio hydrogen

Chemical processes: catalytic p., esterification

ThermoChemical proces: pyrolisis

House of Lords (2014), Villaran et al (2018), OECD (2018)

AgriChemWhey

BBI JU

Flagship project in Ireland to convert dairy side-streams into the value-added products **L-lactic acid, polylactic acid** (an emerging bioplastic), **minerals for human nutrition and bio-based fertiliser.**

The project addresses several CBE policy goals:

- Rural job creation and regional development;
- Relieves pressure on land;
- GHG emissions savings;
- Pollution prevention;
- Waste valorisation;
- Creation of new circular value chains and innovation ecosystems;
- Increases the sustainability of milk production.

BIOVEGE

Puesta en valor para los residuos de la horticultura almeriense en forma de envases y superalimentos.

Extraction of food compounds to get **food preservatives** and **bioactive ingredients**, and **hydrolyzing waster** for alcohols from its sugars to **improve existing bioplastics** to use them as packaging of horticultural products.

Consorcio: ALHÓNDIGA-LA UNIÓN (Líder), DOMCA, NEOL BIO, ECOPLAS, MORERA&VALLEJO, TORRES MORENTE

Centros contratados: AIMPLAS, Fundación CAJAMAR, CIDAF, Tecnalia.

Utilisation of waste bread for fermentative succinic acid production

Leung et al. (2012) **fermented bread** hydrolysate as the sole feedstock for the **production of succinic acid,** with an overall yield of 0.55 g succinic acid per g bread.

This was the **highest succinic acid yield** compared with other food waste-derived media reported at the time.

Succinic acid is considered one of the **future platform chemicals** of a sustainable chemical industry.

It is a **precursor for many chemicals**, with a production capacity of about 30 000 tonnes per year. The projected market value for succinic acid by 2022 is thought to be USD 1.1 billion11.

Project Turns Fish Waste into Value-Added Products

Enerfish: From fish waste to fuel tank
FP 7 Research Project: project to produce **biodiesel** made from the waste generated by a fish-processing plant

Enascuta et al. (2018) **pre-treated fish oil** and through transesterification created saturated and **unsaturated fractions of fatty acid** ethyl esters (FAEE).

- The **saturated content** can be used as **biofuel**
- The **unsaturated FAEE** can be further transesterified with glycerol (already a by-product of biodiesel production) in order to obtain oil rich in **polyunsaturated fatty acids** (PUFAs).

PUFAs are high-value products; therefore this is an example of cascading use of fish waste.

Research & Development 7th July 2017

Roadtrip fuelled on whisky waste

Research at Celtic Renewables Ltd has demonstrated the technology required to convert **whisky wastes into butanol**, an advanced biofuel, via a **microbiological route**.

The company is starting to build a **demonstrator plant** at Grangemouth, Scotland, home of a large petrochemicals complex. It is intended as a commercial demonstrator plant that will produce over **half a million litres of biofuel** each year

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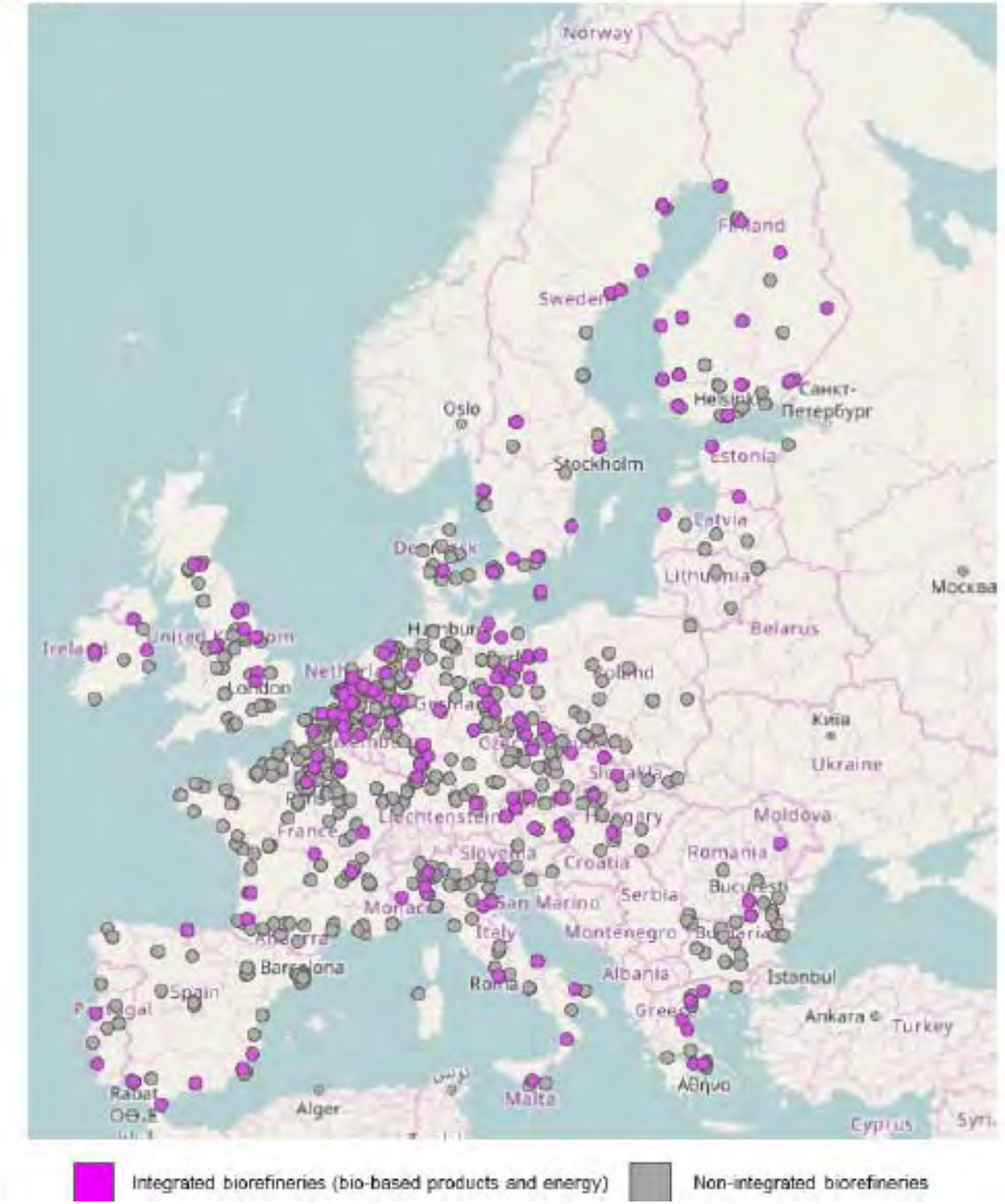
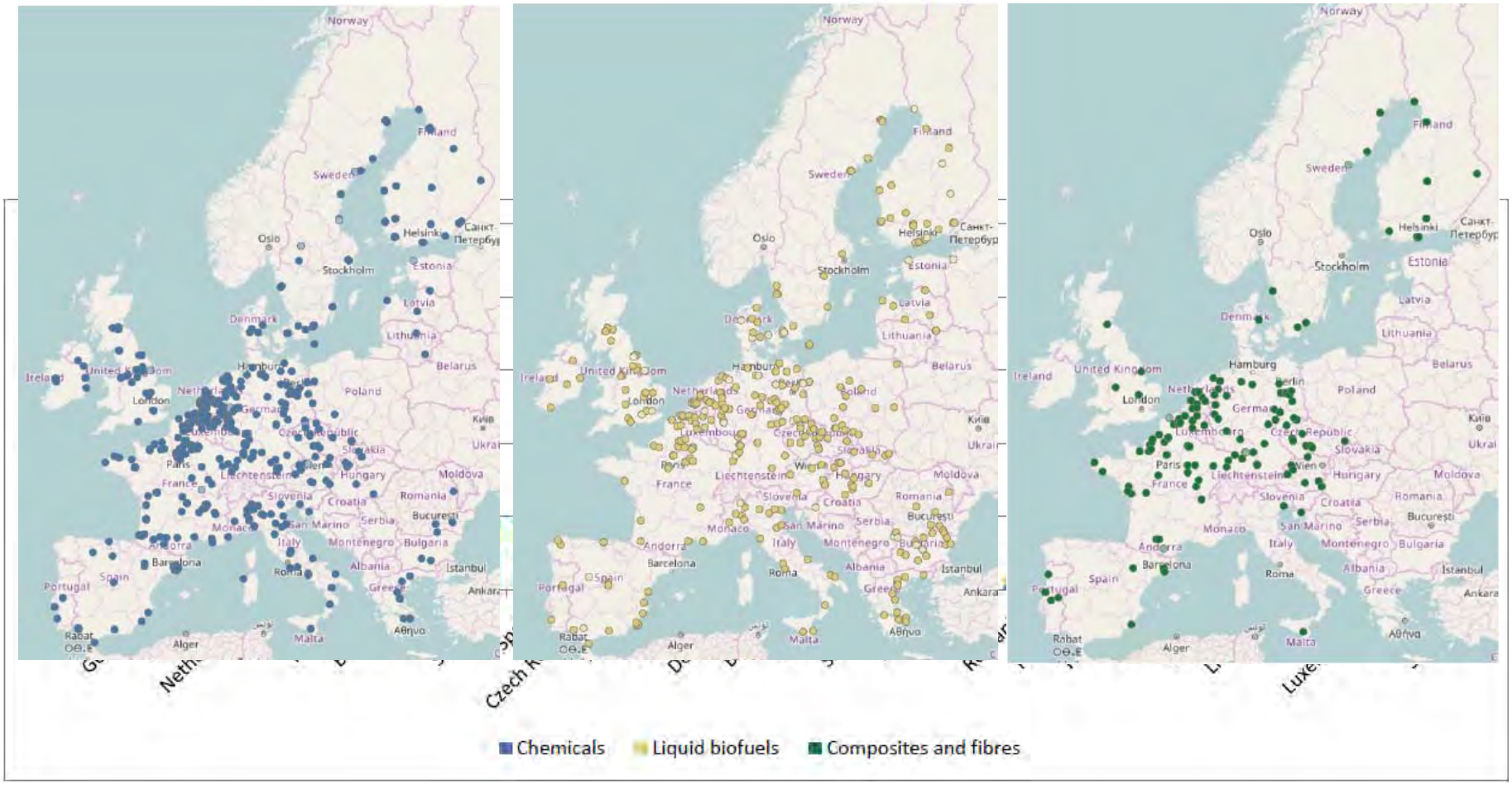
Biorefineries in Spain

39



Fuente: Parisi, C. (2018). "Research Brief: Biorefineries distribution in the EU". European Commission - JRC

Geographical distribution of biorefineries by product groups and countries



Fuente: Parisi, C. (2018). "Research Brief: Biorefineries distribution in the EU". European Commission - JRC

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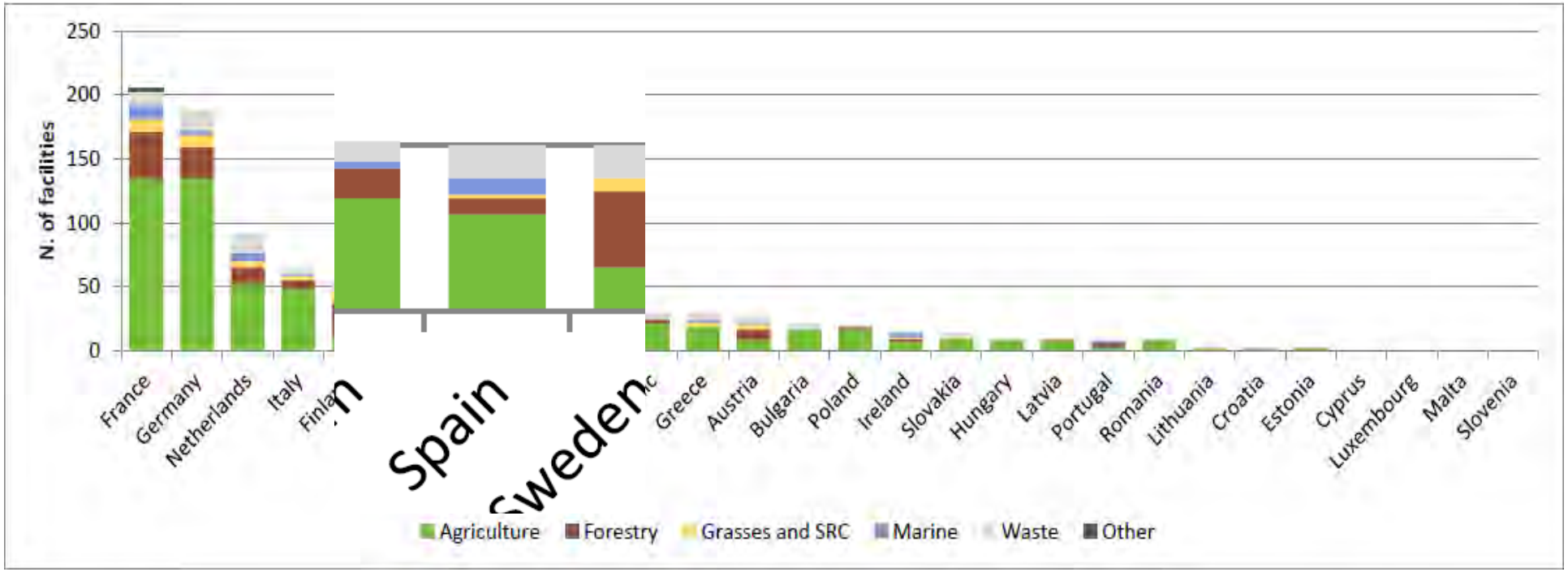
Number of biorefineries by type of biomass used as raw material and country



Fuente: Parisi, C. (2018). "Research Brief: Biorefineries distribution in the EU". European Commission - JRC

Biorefineries in Spain

(JRC data base)

Source: personal comunication from Parisi y M'Barek, 2018

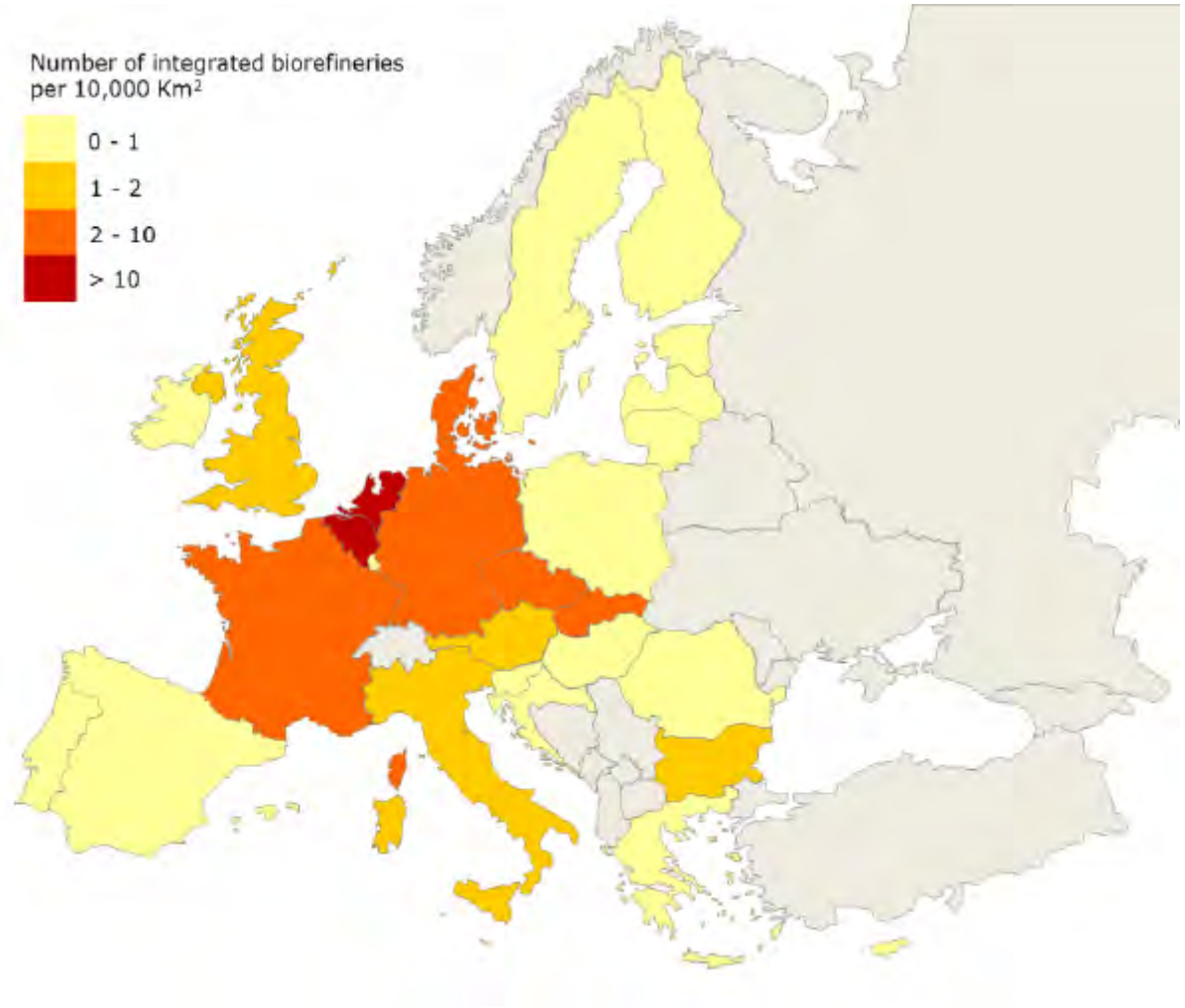
Total number of plants: 39

- 25 produce bio-based chemicals
- 19 produce liquid biofuels
- 4 produce bio-based composites and/or fibres

Raw material source:

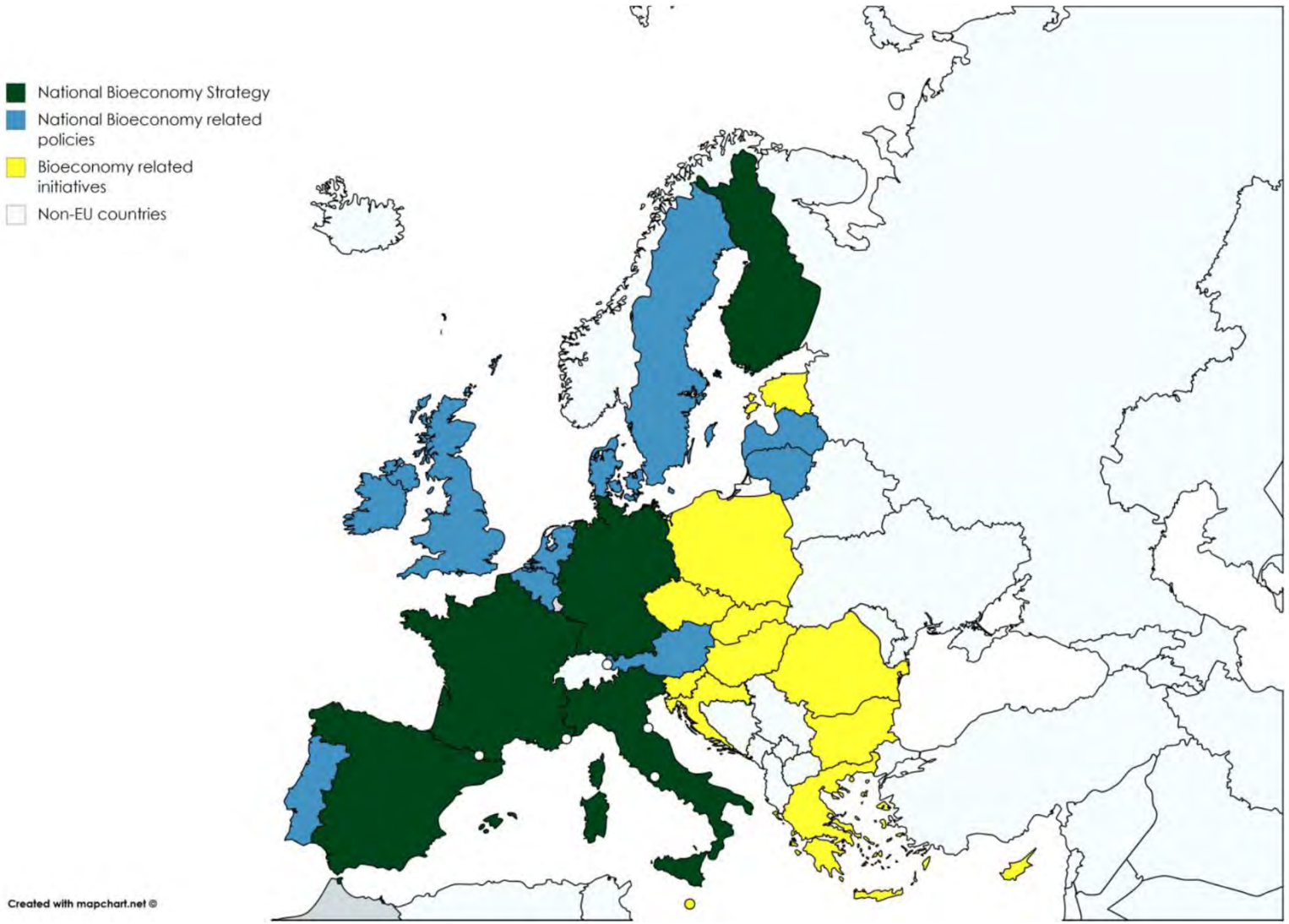
- 29 from agriculture
- 10 from wastes
- 5 from forestry products
- 5 from marine products
- 1 from grases

Per country refineries density




European Commission
REVIEW OF THE 2012 EUROPEAN BIOECONOMY STRATEGY


European Commission
A sustainable bioeconomy for Europe: strengthening the connection between economy, society and the environment
Updated Bioeconomy Strategy
Research and Innovation


National Bioeconomy Strategy
National Bioeconomy related policies
Bioeconomy related initiatives
Non-EU countries
Created with mapchart.net ©

Action Title	Who
1 Strengthen and scale-up the bio-based sectors, unlock investments and markets	
1.1 Mobilise public and private stakeholders, in research, demonstration and deployment of sustainable, inclusive and circular bio-based solutions	Commission, Member States, Regions and stakeholders
1.2 Launch of the EUR 100 million Circular Bioeconomy Thematic Investment Platform	Commission
1.3 Study and analysis of enablers and bottlenecks and provide voluntary guidance to the deployment of bio-based innovations	Commission
1.4 Promote and/or develop standards and emerging market-based incentives, and improve labels applicable to bio-based products on the basis of reliable and comparable data on environmental and climate performance	Commission and Member States/stakeholders
1.5 Facilitate the development of new sustainable biorefineries and confirm the type and estimated potential[44]	Commission and Member States
1.6 Research and innovation investments for the development of substitutes to fossil based materials that are bio-based, recyclable and marine-biodegradable, and of bio-remediation methods by mobilising the key actors in the relevant value chains including the plastics value chain and to contribute to plastic-free, healthy and productive European seas and oceans	Commission, stakeholders

Action Title	Who
2 Deploy local bioeconomies rapidly across Europe	
2.1 A Strategic Deployment Agenda for sustainable food and farming systems, forestry and bio-based production in a circular bioeconomy	Commission, Member States, private sector, stakeholders
2.2 Pilot actions to support local bioeconomy development (rural, coastal, urban) via Commission instruments and programmes	Commission, Member States, regions, municipalities and other stakeholders
2.3 Set up an EU Bioeconomy policy support facility and a European Bioeconomy Forum for Member States	Commission and Member States
2.4 Promote education, training and skills across the bioeconomy	Commission and Member States

Action Title	Who
3 Understand the ecological boundaries of the bioeconomy	
3.1 Enhance the knowledge on the bioeconomy, including on biodiversity and ecosystems, to deploy it within safe ecological limits and make it accessible through the Knowledge Centre for Bioeconomy	Commission, Member States, International Organisations, IPBES
3.2 Increase observation, measurement, monitoring and reporting capabilities and build an EU-wide, internationally coherent monitoring system to track economic, environmental and social progress towards a sustainable bioeconomy	Commission, Member States, private sector
3.3 Provide voluntary guidance to operate the bioeconomy within safe ecological limits	Commission
3.4 Better integrate the benefits of biodiversity-rich ecosystems in primary production through a specific support to agro-ecology, the development of microbiome-based solutions, and new tools to integrate pollinators in supply value chains	Commission, Member States, private stakeholders

Horizon Europe: evolution not revolution

Specific objectives of the Programme

v. 25 June 2018

European Commission

Clusters in 'Global Challenges and Industrial Competitiveness'

Clusters	Areas of intervention	
Health	* Health throughout the life course * Non-communicable and rare diseases * Tools, technologies and digital solutions for health and care	* Environmental and social health determinants * Infectious diseases * Health care systems
Inclusive and Secure Societies	* Democracy * Social and economic transformations * Protection and Security	* Cultural heritage * Disaster-resilient societies * Cybersecurity
Digital and Industry	* Manufacturing technologies * Advanced materials * Next generation internet * Circular industries * Space	* Key digital technologies * Artificial intelligence and robotics * Advanced computing and Big Data * Low carbon and clean industry
Climate, Energy and Mobility	* Climate science and solutions * Energy systems and grids * Communities and cities * Industrial competitiveness in transport * Smart mobility	* Energy supply * Buildings and industrial facilities in energy transition * Clean transport and mobility * Energy storage
Food and Natural Resources	* Environmental observation * Agriculture, forestry and rural areas * Food systems * Circular systems	* Biodiversity and natural capital * Sea and oceans * Bio-based innovation systems

Thank you very much

Muchas gracias

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