

# **1ST VIRTUAL WORKSHOP**

# **Boosting circular economy in cities through** new models of municipal solid waste management. **The URBIOFIN biorefinery concept**

June 16<sup>th</sup>, 2020









# AGENDA

10:00	Welcome and Introduction <i>Caterina Coll, IMECAL</i>	11:3
10:10	R&I solutions for the territorial deployment of a sustainable, regenerative, inclusive and just circular economy <i>Andrea Accorigi, EC</i>	11
10:25	Achieving Circular Economy in Municipalities Vanya Veras, MWE	:4
10:40	LIPOR strategy for biowaste. The Porto region case Telmo Machado, LIPOR	11:
10:55	Round table <i>Moderator: Caterina Coll</i>	
11:10	Q&A	12:0
11:25	URBIOFIN Project: a new urban biorefinery model <i>Caterina Coll, IMECAL</i>	12:

Transforming municipal solid waste into bioethanol and bio ethylene for value-added market applications (Demo I)
 Marcos Latorre, IMECAL

Combining AD and other fermentation technologies for a new generation of biopolymers aimed at cosmetic and agricultural applications (Demo II) *Juan Carlos López, ainia Centro Tecnológico* 

The role of biogas/anaerobic digestion in the future of Urban Biorefineries: Production of higher-value
:50 biostimulants and biopolymers with algae and bacteria (Demo III) *Víctor Pérez, University of Valladolid*

2:00 Q&A

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12:10 Wrap-up & closure of the workshop

# Welcome and Introduction

Caterina Coll Lozano Innovation Manager IMECAL S.L URBIOFIN Project Coordinator





URBISFIN

MSW : a growing social and environmental problem in Europe and worldwide



Current global MSW generation levels: 1.3 billion tonnes per year. Expected to be double by 2025.

251 Million tons MSW generated in Europe in 2018

- Recycling 30%
- Landfill 23%
- Incineration 28%
- Composting and Digestion 17%

#### The opportunity

About <u>100 Mt of municipal biowaste</u> are generated every year in Europe.

Only about a third (30 Mt) of this was separately collected and composted and/or digested.



This Project has received funding from the Bio-Based Industries Joint Undertaking under the European

Legislative drivers

#### Revised legislative framework on waste entered into force in July 2018:

- ➤ A common EU target for recycling 65% of MSW by 2035 (Directive 2018/851/EU).
- Separate collection obligation of biowaste by the end of 2023 (Directive 2018/851/EU).
- > A target to reduce landfill to maximum of 10% of MSW by 2035 (Directive 2018/850/EU).

#### EU action plan for the Circular Economy.

#### EU Bioeconomy Strategy COM (2018) 673

#### Renewable Energy Directive 2018/2001/EU

➤ 12 % share of energy from renewable sources in transport by 2030, Maximum 7% of 1<sup>st</sup> generation biofuels in transport.





Value proposition: Urban biorefinery Model





#### Value proposition: Urban biorefinery Model



**Profitability** 

**Higher annual benefits**, when compared to current MSW technologies.



**Versatility** to treat different fractions of waste to obtain maximum added value and profitability



Improvement of the performance through the **use of by-products generated** in their own processes – **landfill diversion.** 



Waste is a resource: Circular economy.

**Circular Economy** 

ir own processes – **landfil** ersion.



Reduction of fossil resources dependence in energy and products.



Boost competitiveness, foster sustainable economic growth and generate new jobs

**Sustainability** 

#### **Biorefinery projects**









# R&I solutions for the territorial deployment of a sustainable, regenerative, inclusive and just circular economy

# Urban circular bio-based economy Circular Cities and Regions Initiative (CCRI)

Andrea Accorigi andrea.accorigi@ec.europa.eu DG RTD – Circular Economy & Bio-based Systems



# 1. Urban circular bio-based economy



# In-house primary research from 2015

#### **Bio-waste and wastewater management schemes:**

- Technical, regulatory and financial aspects

#### **Bio-based technologies and value chains:**

- Technical, regulatory and financial aspects

Role of the European Commission in supporting an urban circular bioeconomy



# Technology readiness level (TRL) upgrade

#### **Research and Innovation Actions - RIAs (Pilots)**:

- H2020 project <u>RES URBIS</u>
- BBI JU project PERCAL

#### Innovation Actions - IAs (Demos):

- BBIJU EMBRACED
- BBI JU URBIOFIN



# System innovation in urban metabolism

#### Innovation Actions - IAs (Demos):

- H2020 SCALIBUR
- H2020 VALUEWASTE
- H2020 WaysTUP!

Flagship topic - Call closure: 3 September 2020, 17:00 CET.

<u>BBI2020.SO1.F1 – Valorise the organic fraction of municipal solid waste through an</u> <u>integrated biorefinery at commercial level</u>



# **Project Development Assistance (PDA)**

#### CE-FNR-17-2020

#### Pilot circular bio-based cities – sustainable production of bio-based products from urban biowaste and wastewater

'Project Development Assistance (PDA) to a pilot group made up of at least 5 European cities (and/or clusters of cities) to build their technical, economic and legal expertise needed for leading to concrete investments in projects to valorise urban biowaste and wastewater through the production of safe and sustainable bio-based products, including the innovative ones'.

https://ec.europa.eu/info/funding-tenders/opportunities/portal/screen/opportunities/topic-details/ce-fnr-17-2020



# Regulation

EU Urban Agenda - Partnership on CE - ACTION PLAN:

- Survey report on regulatory obstacles and drivers for boosting an urban circular bioeconomy: preliminary analysis of the EU regulatory obstacles and drivers influencing the production of biobased products from urban biowaste and wastewater
- New booklet on Better Regulation in a Circular Economy



# **Financial aspects**

EU Urban Agenda - Partnership on CE - ACTION PLAN:

- Circular City Funding Guide: <u>https://www.circularcityfundingguide.eu</u>
- 1) provide information on financing and funding sources that are available for circular initiatives and projects, and
- 2) provide guidelines for setting up funding programmes to support the transition to a circular economy.



# 2. Circular Cities and Regions Initiative (CCRI)



# **Circular Cities and Regions Initiative (CCRI)**

Status: setting-up

Focus: implementation of circular territorial solutions.

https://ec.europa.eu/research/environment/index.cfm



# **European Green Deal Call**

Draft topic 2: Demonstration of systemic solutions for the territorial deployment of the circular economy

**Aim**: [...] support: (i) pilot applications, demonstration projects and innovative products, (ii) innovation for better governance of the green and digital transition, and (iii) social and value chain innovation [...].

The Green Deal call is composed of 11 areas: [...] Call area 3: Industry for a clean and circular economy [...]

#### Topic 2: Demonstration of systemic solutions for the territorial deployment of the circular economy

<u>Disclaimer</u>: The presentation of draft topics and the opportunity to give feedback provided to stakeholders shall in under no circumstances bind the European Commission in the final formulation of topics for the call. The binding call text will be published following the formal decision by the European Commission on the <u>Funding and tender opportunities portal</u>.



# European Green Deal Call

#### 3 June 2020

- Deadline for giving your online feedback for the call

mid-September 2020

- Formal adoption of Green Deal call as amendment to Horizon 2020 work programme 2018-20

#### mid-September 2020

- Publication and opening of the call

#### 22-24 September 2020

- Opportunity to find potential project partners at the EU R&I Days

end January 2021

- Deadline for submitting project proposals

# LIPOR strategy for biowaste The Porto region case

Telmo Machado R&D&I Unit at LIPOR





#### LIPOR

LIPOR - Intermunicipal Waste Management of Greater Porto is responsible for the management, recovery and treatment of the Urban Waste produced in the associated municipalities.

8 1.000.000

Municipalities

lipor

Inhabitants

# $\approx 500.000 t$

Urban Waste Production





# LIPOR strategy for biowaste LIPOR The city of Porto case Municipalities Waste flows Recyclables Mixed waste Baguim do Monte (Gondomar) Moreira da Maia (Maia)



#### **BIOWASTE MANAGEMENT**



#### MANDATORY SEPARATE COLLECTION OF BIOWASTE BY 2023



#### DISTRIBUTE THE EFFORT OF WASTE MANAGEMENT





#### ON SOURCE REDUCTION AND REUSE AND DECENTRALISED TREATMENT



#### Prevention of food waste

#### Urban food production

Local composting

**Composting Parks** 



#### CENTRALISED TREATMENT/VALORISATION

Ecocentros / Drop off sites

Separate collection Households and private enteties

Separate collection - cemeteries









Municipal collection – non-residential Separate collection Households and private enteties Municipal collection – Residential



#### A PRODUCT POINT OF VIEW

Its not waste, it's a resource for making quality products









#### **R&D & INNOVATION**





Compostable products testing

Biodegradable product development advisory



New products development from and with microalgae



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#### THE FUTURE OF BIOWASTE MANAGEMENT



#### THE FUTURE OF BIOWASTE MANAGEMENT











Q&A



# URBIOFIN Project: A new urban biorefinery model

Caterina Coll Lozano Innovation Manager IMECAL S.L URBIOFIN Project Coordinator





**URBIOFIN: Value proposition** 



Demonstration of an integrated innovative biorefinery for the transformation of Municipal Solid Waste (MSW) into new BioBased products (GA 745785)





#### **Project Objective**





#### **URBIOFIN** Demo plants



IMECAL. PERSEO Biorefinery® Plant



**URBASER.** Centro Alfonso Maillo



**IRIAF. CLAMBER Demo Plant** 





#### **URBIOFIN** Project status





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#### URBIOFIN Consortium





www.urbiofin.eu | imecal@imecal.com | 🖤 @URBIOFIN | in URBIOFIN Project





# Transforming municipal solid waste into bioethanol and bioethylene for value-added market applications (Demo I)

Marcos Latorre IMECAL





#### Overview

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#### **TRANSFORM THE ORGANIC and CELLULOSIC WASTE into Advanced fuels, Bioproducts and Bioenergy**



#### **BIOREFINERY FROM ORGANIC WASTE since 2007**





#### PERSEO Bioethanol® process





#### **URBIOFIN** Demo I Conversion of bioethanol into bioethylene OFMSW Bioethanol Distillation Pretreatment SSF S/L separation (95%) **Bioethanol** Feed Bioethylene Dehydration $\square$ Evaporation Separation pressurization (95%) (99%) $C_2H_5OH \rightarrow C_2H_4 + H_2O$ FIN

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#### **Bioproducts markets**

#### **Bioethanol**

- ✓ The global bioethanol market size is projected to grow from USD 33.7 billion in 2020 (110 billion L) to USD 64.8 billion by 2025
- ✓ In Europe, it is predicted that the bioethanol market will grow from 3 billion € in 2013 to
   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)





#### **Bioproducts markets**

#### **Bioethylene**

- ✓ Ethylene is the **most commercially produced** organic compound in the world (140 M ton)
- ✓ It is primarily a monomer used as a feedstock in the manufacture of **plastics, fibers and other chemicals**
- ✓ The global ethylene market size was valued at USD 146.3 billion in 2019 and is anticipated to grow at a CAGR of 9.8% in the next 5 years









#### Advantages of producing bioproducts from OFMSW

- ✓ Integrable technology in current MSWT plants
- ✓ Higher incomes due to the sale of bioproducts
- ✓ In line with the Circular Economy Action Plan (2020) Bioeconomy Action Plan one of the main blocks of the EU Green Deal
- ✓ Contribute to the **reduction of GHG emissions** in waste management
- ✓ Increase biodegradable MSW recycling rate, in line with new WF and Landfill Directives (2018)









# Combining AD and other fermentation technologies for a new generation of biopolymers aimed at cosmetic and agricultural applications (Demo II)

Juan Carlos López





**G**F I N

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#### Demo II. Anaerobic Digestion Technologies: Current status



Demo II. Anaerobic Digestion Technologies: Prospects of biorefinery



- How to circumvent volatility of market and price indexes of fossil fuels?
- Identify and explore alternative paths to create value apart from bioenergy within a biorefinery approach (1000 €/ton organic waste)



This Project has received funding from the Bio-Based Industries Joint Undertaking under the European Union's Horizon 2020 research and innovation programme under grant agreement N° 745785

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# Demo II. Anaerobic Digestion Technologies: Prospects of biorefinery



VFAs are chemical building blocks with increasing market demand (3-15 % CAGR, ~20 Mton/year)

Wide range of applications, and a valuable raw material for more valuable products

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# Demo II. Anaerobic Digestion Technologies: Prospects of biorefinery



- It is feasible to create additional value and avoid VFA's downstreaming process?
  - PHAs (2,000-10,000 €/ton; 32 Mton/year) rank among the most interesting and demanded options

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Demo II. Anaerobic Digestion Technologies: Prospects of biorefinery



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Demo II. Anaerobic Digestion Technologies: Prospects of biorefinery

- mcl-PHA production with pure culture with elongation abilities



# Demo II. Anaerobic Digestion Technologies: Prospects of biorefinery



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# Demo II. Anaerobic Digestion Technologies: Prospects of biorefinery



# The role of biogas/anaerobic digestion in the future of Urban Biorefineries: Production of higher-value biostimulants and biopolymers with algae and bacteria (Demo III)

Víctor Pérez University of Valladolid





### The role of biogas and anaerobic digestion: Up to now

AD technologies have reduced significantly the amount of organic waste sent to landfill

>18,000 operative plants in Europe are able to recover energy (biogas) and nutrients (lixiviate) from organic waste



Fiscal incentives on renewable energy production have contributed to an electric capacity of ~10,000 MW



### The role of biogas and anaerobic digestion: Today

Increasingly restrictive environmental policies

Higher attention toward solar/wind options

Circular economy directives

Production costs reduction by 13% (2017-2018)

End of feed-in tariffs on renewable energy production

High capital and maintenance cost for CHP



(ACS Sustainable Chemistry & Engineering 2020, 8, 20, 7701-7709)

#### The role of biogas and anaerobic digestion: Tomorrow

#### Microalgae and bacteria can transform biogas into multiple bioproducts:

- Biomethane (for natural gas grid injection or automotive fuel)
- Aminoacid-rich microalgal biostimulants
- Polyhydroxyalkanoates (biopolymers)







Photosynthetic biogas upgrading: Biomethane and biofertiliser





Photosynthetic biogas upgrading: A sustainable process for Urban Biorefineries





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Photosynthetic biogas upgrading: URBIOFIN Project



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Polyhydroxyalkanoates (PHA) from CH<sub>4</sub>-Biogas Production of biopolymers



#### Polyhydroxyalkanoates (PHA) from CH<sub>4</sub>-Biogas Techno-economic analysis



(ACS Sustainable Chemistry & Engineering 2020, 8, 20, 7701-7709)



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#### Polyhydroxyalkanoates (PHA) from CH<sub>4</sub>-Biogas Sustainability analysis



#### Take-home messages

Biogas-to-energy economic feasibility is compromised by the reduction of fiscal incentives and the decreasing production cost of solar/wind energies

A wide portfolio of bioproducts can be produced from biogas in waste treatment facilities

Decreasing energy prices and new directives on circular economy promote biogas valorisation in future Urban Biorefineries

Photosynthetic biogas upgrading with microalgae represents a competitive technology in the growing biomethane market

Biopolymer production in waste treatment facilities is an economically viable, social responsible and environmentally-friendly alternative to current biogas valorisation schemes





Q&A



# Wrap-up & closure of the workshop

Caterina Coll Lozano Innovation Manager IMECAL S.L URBIOFIN Project Coordinator







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Horizon 2020 European Union Funding for Research & Innovation